ANALYSES OF MEASUREMENTS FROM THE CRATER INSTRUMENT ON THE LRO SPACECRAFT USING SPACE RADIATION TRANSPORT CODES

A Dissertation
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DEDICATION

For my fiancé,

Terry Termaine Porter

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ABSTRACT

In June 2009, the Lunar Reconnaissance Orbital (LRO) Spacecraft was launched to orbit Earth's Moon. Objectives of this mission are to find potential safe landing sites, locate potential resources, test new technologies, and characterize the lunar radiation environment. Located on the LRO is the Cosmic Ray Telescope for the Effects of Radiation (CRaTER) instrument which is designed to characterize the lunar radiation environment, its biological impact on humans, and impact on equipment. CRaTER will provide a better and more accurate understanding of the lunar radiation environment by measuring linear energy transfer (LET). This lunar environment includes solar particle events (SPEs) and high energy galactic cosmic rays (GCRs). To predict and support CRaTER's observed data, a comparison to benchmarked radiation transport codes is necessary. The goal of this dissertation is to compare CRaTER's observed data to simulated results from the Monte Carlo code, High Energy Transport Code – Human Exploration and Development in Space (HETC-HEDS) and the deterministic code, High-Charge-and-Energy Transport (HZETRN). A central part of these analyses is separating the contributions of secondary particles, produced by nuclear interactions in the instrument, from the contributions of these incident primary ions. Also included is a simple analysis of the effects of escaping delta rays on the instrument output spectra.

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1. INTRODUCTION

NASA launched the Lunar Reconnaissance Orbital (LRO) Spacecraft in June of 2009 with the purpose of someday sending a manned mission to Earth's Moon. LRO carries an instrument called the Cosmic Ray Telescope for the Effects of Radiation (CRaTER). CRaTER is used to characterize the lunar radiation environment using measurements of linear energy transfer (LET). LET is a useful measurement related to biological effects from radiation exposure.

In prior work, CRaTER has been characterized using computational data from High Energy Transport Code – Human Exploration and Development in Space (HETC-HEDS) [1], [2], [3], [4], [5], [6], [7], [8], [9], [10], [11], [12], [13], [14], [15], [16]. These simulations were used to better understand the detector's responses to radiation.

This dissertation presents a comparison of observed data from the CRaTER detector to the predictions from the HETC-HEDS and HZETRN codes [17]. Our goals are to understand and explain the similarities and differences between observed data and simulated results. In the future, further research is needed to accommodate the current changes being carried out to correct observed data.

1.1. Justification and Originality

The lunar environment is extremely different from that near Earth. Since the Moon lacks an atmosphere and has only a very weak magnetic field, it does not shield astronauts or their equipment from intense space radiation. The radiation

sources at the Moon include high-energy galactic cosmic rays (GCRs) which can limit or end an astronaut's career. Even worse, solar particle events (SPEs) can occur and may be lethal. This harsh environment makes it necessary to have the ability to predict what the radiation environment will be for a manned lunar mission.

Though there have been other instruments in the past used to study the Moon's environment, CRaTER is the first to determine the biological risks involved in lunar exploration. CRaTER directly measures energy deposition, which is used to determine the linear energy transfer (LET) of the radiation environment. LET is the rate of energy loss by a charged particle per unit distance traveled. LET is an important measurement in determining the biological impact of charged particles on human tissue.

In order to determine the most accurate means of predicting the radiation environment for future manned missions, the University of Tennessee, University of New Hampshire, Harvard-Smithsonian Center for Astrophysics, and the Aerospace Corporation work together to compare and contrast the observed data returned from the LRO orbit and simulations from various computer codes.

In earlier research [18], LET look-up tables have been produced using the HETC-HEDS code to act as a one of the prediction models [19]. These tables were used in conjunction with Badhwar-O'Neill GCR model to produce a flux spectrum for direct comparison with observed data. After results were analyzed, it was determined that improvements to the LET look-up tables were needed. This work will expand the original LET look-up tables by separating primary and

secondary particles to improve the correlation between simulated data and observed data for HETC-HEDS. HZETRN 2010 is a space radiation code that was not previously used in these analyses. A comparison of these two prediction models with CRaTER data will provide a good understanding of the lunar radiation environment and help understand the biological impact for future missions.

1.2. Goal of Dissertation

CRaTER measures energy depositions which can be converted to linear energy transfer (LET) spectra. Using the radiation transport codes HETC-HEDS and HZETRN, the updated and original features of this work are as follows:

1. Using HETC-HEDS, calculate LET spectra for primary and secondary particles separately on a per incident particle basis for each of the CRaTER components. This is done using CRaTER's full field of vision (35 degree acceptance detector angle). This is new and original work.
2. Construct new LET lookup tables for use in mission data analyses using HETC-HEDS (a revision of prior work).
3. Using the HZETRN 2010 code and the Badhwar-O'Neill GCR model, compute an LET spectrum for each CRaTER component. This is new and original work.

4. Compare results from HETC-HEDS and HZERTN 2010 simulations for representative GCR spectra likely to be encountered by CRaTER. This is new and original work.

5. Compare results from HETC-HEDS and HZETRN 2010 calculations with actual spectra from the CRaTER mission. This is new and original work.

1.3. Outline of Dissertation

This dissertation is arranged by Chapters containing the following:

Chapter I is an introduction to the basic ideas and motivation behind this research.

Chapter II discusses to the radiation environment at the Moon including radiation sources and plausible interactions. Also included is the importance of LET.

Chapter III overviews the LRO mission including a description of the CRaTER instrument composition and layout.

Chapter IV gives a detailed description of the HETC-HEDS and HZETRN codes. A further explanation of the Badhwar-O'Neill model is also included.

Chapter V describes structure and methodology used for transport codes.

Chapter VI compares and analyzes the observed CRaTER data, simulated HETC-HEDS data, and simulated HZETRN data.

Chapter VII includes the conclusions and suggestions for future work.

2. LUNAR RADIATION ENVIRONMENT

The Lunar radiation environment is much different than Earth's. Fluxes of charged particles and photons originating from solar and galactic sources constantly flood the lunar surface. This bombardment of particles covers a broad range of energies that exceed many GeVs. Figure 1 depicts the radiation environment at the Lunar surface [20].

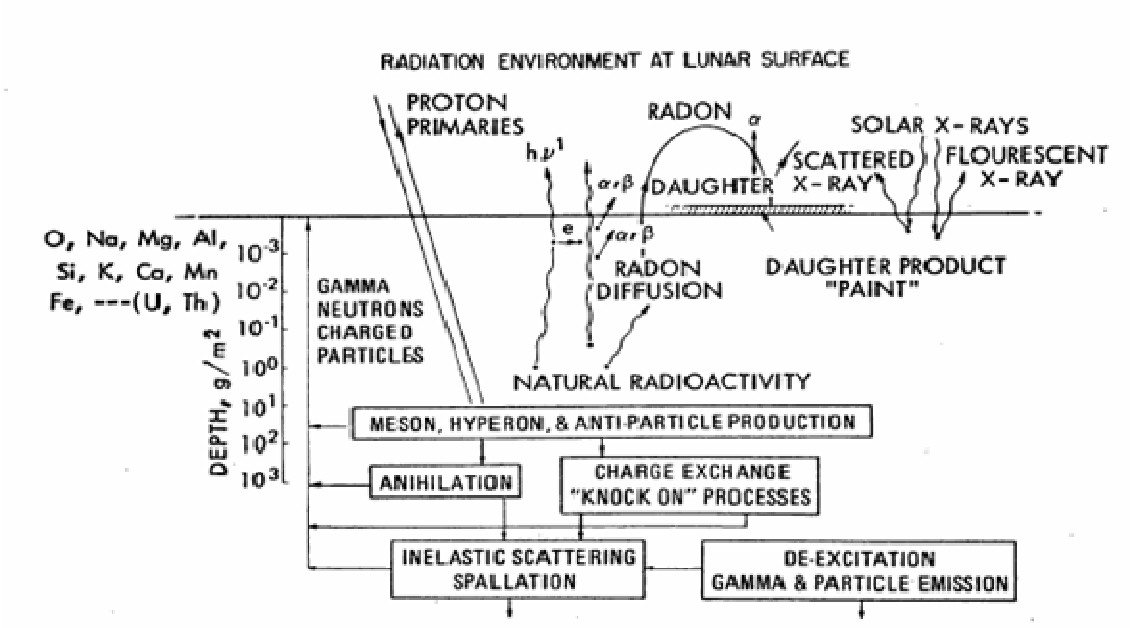


Figure 1. The Lunar Surface Radiation Environment [20]

This radiation environment is damaging physically and biologically. Though not especially biologically important, radiations with low energies can be a problem from a material point of view. Biologically, radiation exposures can limit or permanently end an astronaut's career. Thus without proper shielding, human return to the moon for an extended time period may not be possible [21].

Dose is a measure of the energy deposited in a tissue or medium by ionizing radiation per unit mass. It is typically expressed in units of Gray (Gy) where 1 Gy = 1 J/kg. Dose limitations to protect astronauts from future health problems are listed in Table 1 [22]. The units in Table 1 are mGy-Eq which is equal to dose (mGy) x RBE(relative biologic effectiveness). RBE is defined as the ratio of doses of particles to those of gamma rays that produce an equivalent biological effect [23].

Table 1. Dose limits for Short-term or Career Non-Cancer Effects [22]

Organ	30-day Limit	1 Year Limit	Career Limit
Lens*	1000 mGy-Eq	2000 mGy-Eq	4000 mGy-Eq
Skin	1500	3000	6000
BFO	250	500	Not applicable
Heart**	250	500	1000
CNS***	500	1000	1500
CNS*** (Z≥10)	-	100 mGy	250 mGy

*Lens limits are intended to prevent early (<5 yr) severe cataracts (e.g., from a solar particle event). An additional cataract risk exists at lower doses from cosmic rays for sub-clinical cataracts, which may progress to severe types after long latency (>5 yr) and are not preventable by existing mitigation measures. However, they are deemed an acceptable risk by NASA.

**Heart doses calculated as average over heart muscle and adjacent arteries.

***CNS limits should be calculated at the hippocampus.

Though solar wind is a source of radiation, its energies are so low that they are of no threat to astronauts since a space suit provides adequate protection. There are two major sources of radiation that make the Lunar radiation environment potentially dangerous without the proper shielding: galactic cosmic rays (GCRs) and solar energetic particles (SPEs) [23].

2.1. Galactic Cosmic Rays

While the origin of GCRs is unknown, it's thought that they come from supernovae explosions. The GCR spectrum is composed of high energy penetrating particles that cover the full range of the periodic table. Figure 2 shows the abundances of GCR elements in at 1 TeV in deep space compared to the abundances of those same elements in the solar system bodies.

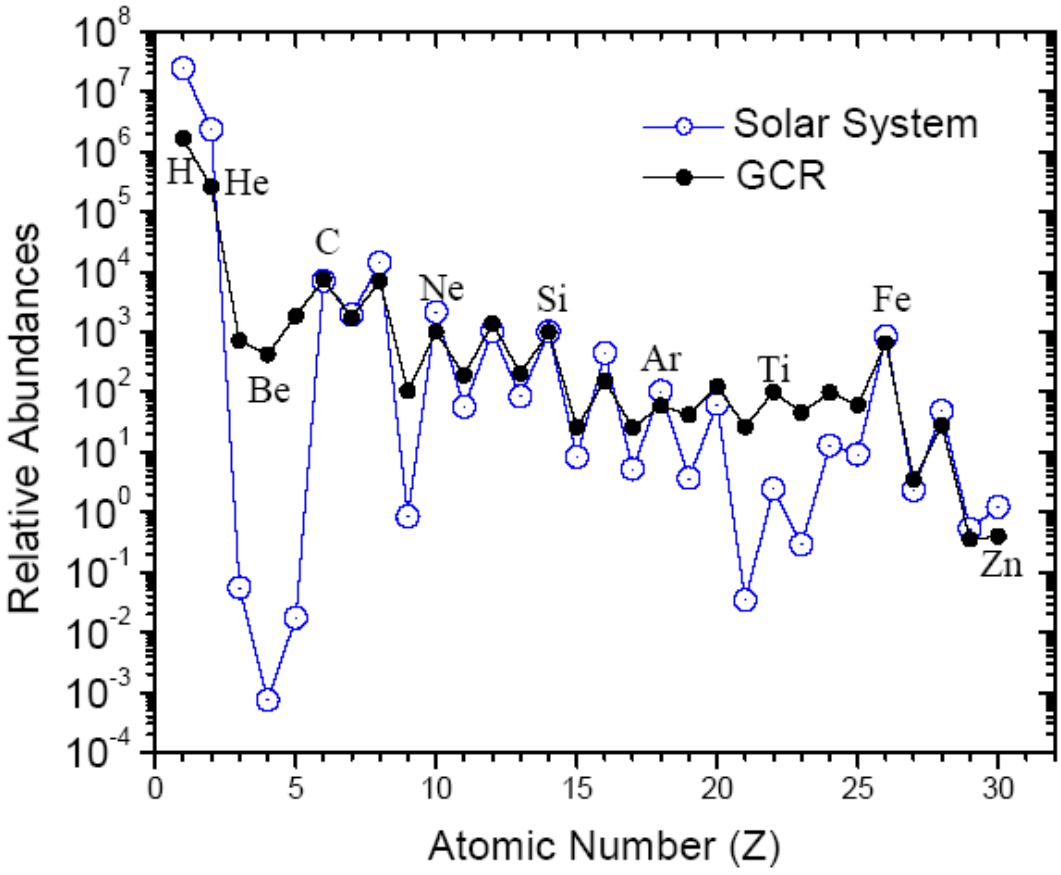


Figure 2. Abundances of Elements in GCR and Solar System [24]

As shown in the figure, the GCR flux spectrum drops off significantly for nuclei heavier than iron. The GCR flux is 98% baryons and 2 % electrons. Although the baryons consist of 85% protons, 14% helium and only 1% heavy ions, heavy ions are particularly damaging because they have larger charge and hence deposit higher doses. Linear energy transfer (LET) and dose measurements are directly correlated with energy deposition [23]. Figure 3 shows percent relative contributions to fluence, dose and dose equivalent from the more abundant ions.

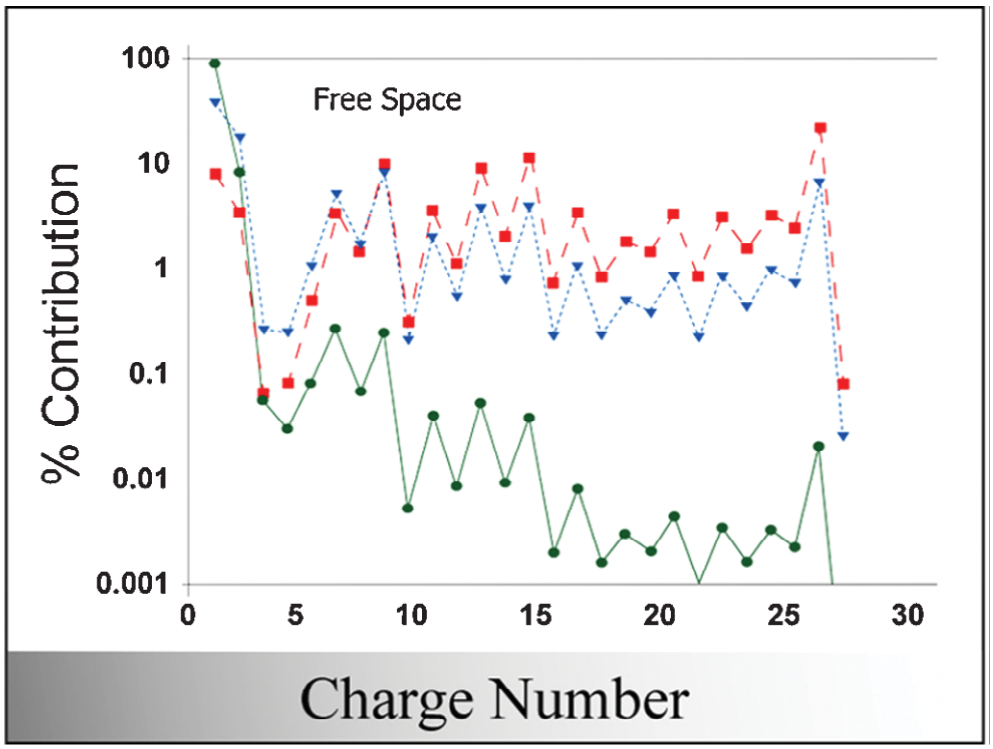


Figure 3. Relative contribution of elements in GCR (relative contribution of fluence is represented by green circles; dose contribution by blue triangles, and the dose equivalent contribution by red squares) [26]

In figure 3, the relative contribution of fluence is represented in circles (green), dose contribution is in triangles (blue), and the dose equivalent contribution is in squares (red). The primary abundances of concern for GCRs are energies from 1 MeV to tens of GeV. Since ions heavier than iron have such low fluxes, they are considered to be insignificant since they contribute little to radiation exposure. One of the main concerns with GCRs is their biological effect resulting from their intense ionization properties.

GCR spectra are dependent on solar activity. During solar minimum, GCR fluxes are at their maximum. While in solar maximum, GCR fluxes are minimized. When solar activity increases, there is an increase in solar wind that causes an outflow of ions propagating from the sun. Magnetic fields are stronger during this high activity and deflect the lower energy GCR ions which causes GCR ions at solar maximum to be less biologically dangerous.

Figure 4 shows the flux differences in solar minimum (solid line) and solar maximum (dotted line).

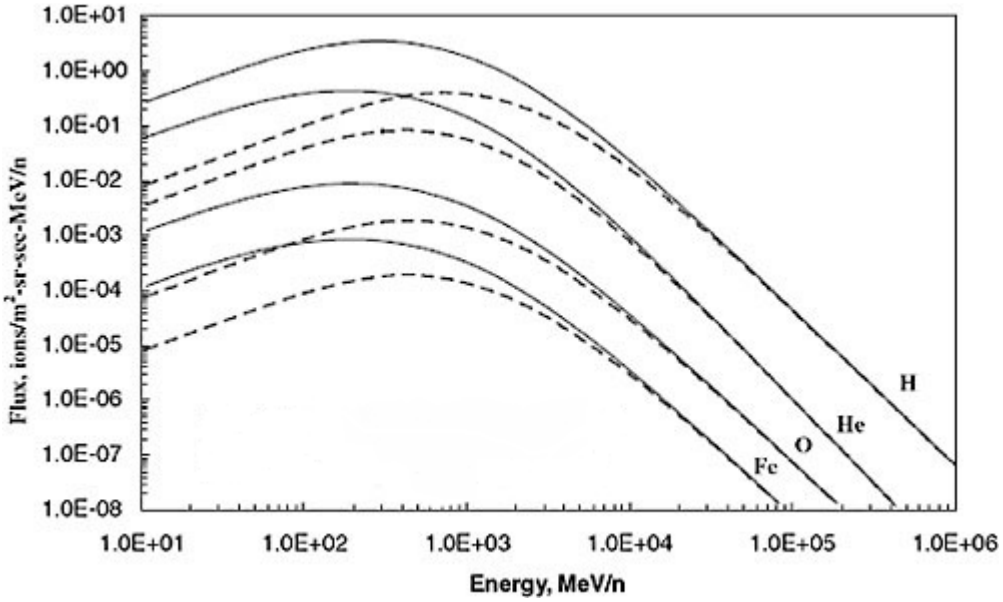


Figure 4. Differential solar energy spectra at 1977 solar minimum and 1959 solar maximum [23]

A complete solar cycle is approximately 11 years. During this time, solar minimum and solar maximum are experienced. The change in the GCR exposures ranges over a factor of 2 throughout the cycle.

2.2. Solar Energetic Particles

Solar energetic particles are protons (more than 90%), alphas, and some heavier particles with high energies. Though they are not common near sunspot minimum, SPEs can occur at any point in the solar cycle. SPEs can last from hours to days at a time with no prediction of length or intensity [26]. The Space Weather Prediction Center (SWPC) of NOAA declares that an SPE is occurring when the rate of particles with energies greater than or equal to 10 MeV exceeds 10 particles/cm2-sec-ster for more than fifteen minutes [27]. An energetic SPE is when the particles with energies greater than or equal to 100 MeV exceed 1 particle/cm2-sec-ster [28]. Not all SPEs are of importance to astronauts because of their low intensities at higher penetrating energies [26] or nonthreatening trajectories. SPEs can generate particles capable of penetrating spacecraft material and disturbing electronic systems. Some of the strongest events can cause doses that could be lethal to an astronaut outside of the space craft for [29]. Figure 5 shows the integral flux versus energy from several past large SPEs.

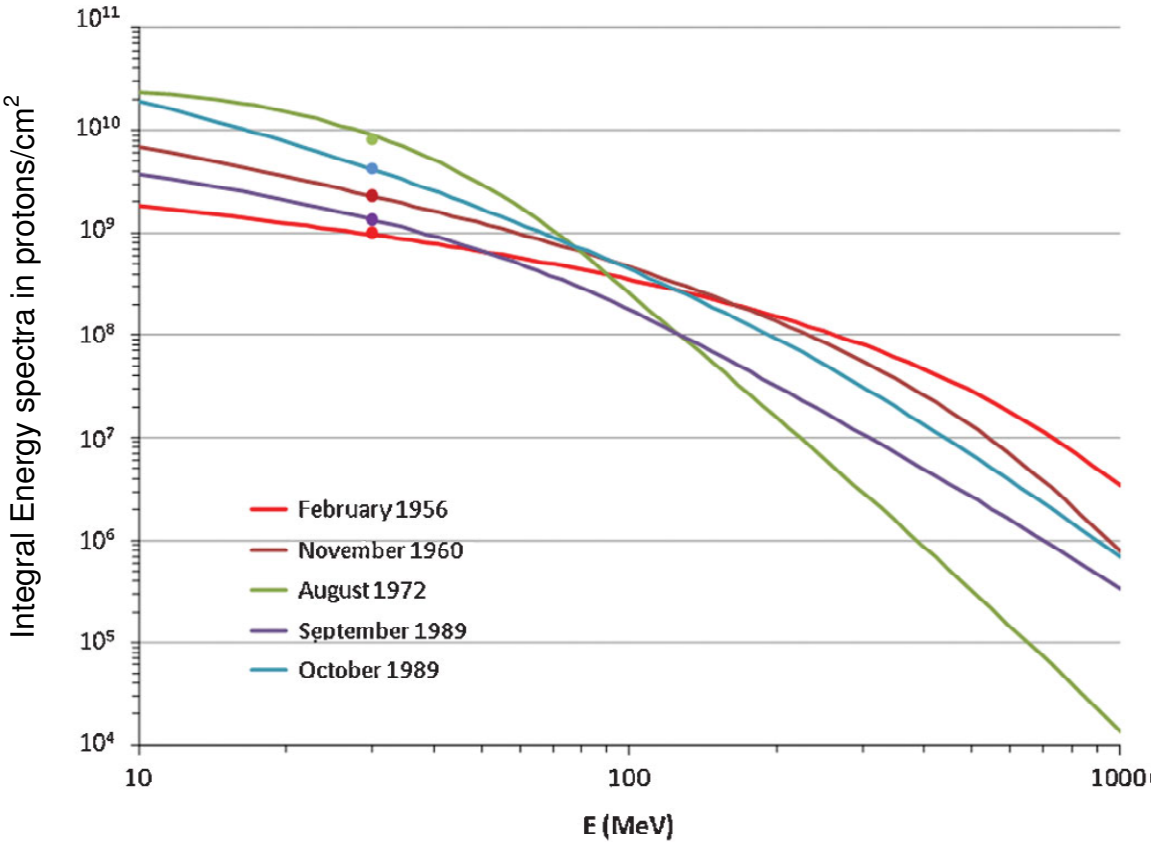


Figure 5. Integral energy spectra of intense large solar particle events [23]

2.3. Space Radiation Interactions

In space, there is a multitude of energetic particles that have a very broad energy range. Figure 6 shows the compositions of space radiations with their corresponding energies and fluxes for different sources [20].

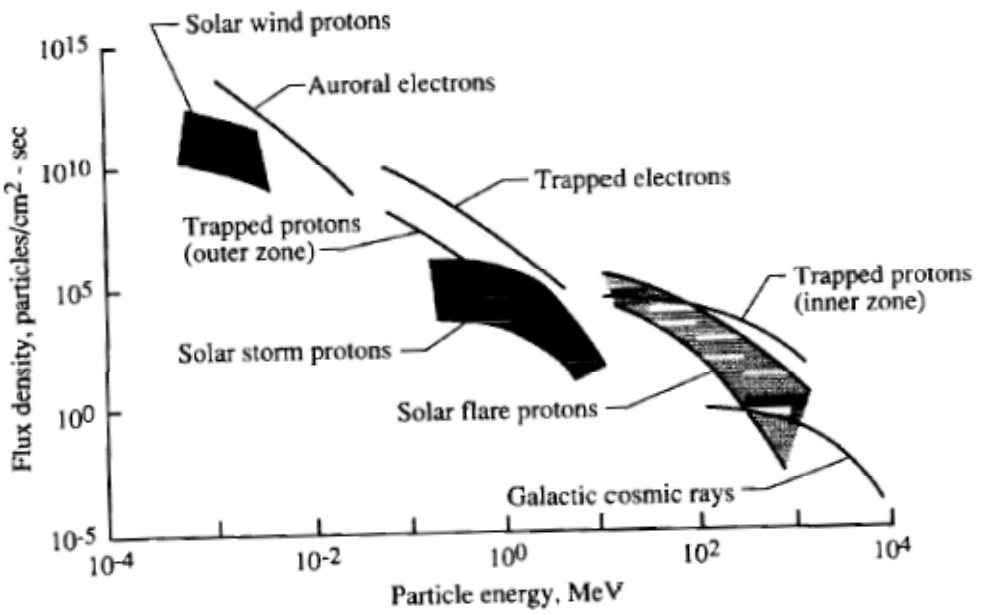


Figure 6. Space Radiation Environment [21]

When looking at the structure of an atom, electrons only account for 0.05% of the mass while 99.95% is the atomic nucleus. Even though electrons make up such a small portion of the mass, they take up almost all the space of the atom. Nuclei are 10^{-5} smaller than the atom as a whole. Since the majority of space is filled with electrons, it's clear that a particle passing will more likely strike an electron instead of the nucleus.

Particle interaction results in energy loss. Atomic and molecular excitation and ionization are the two main causes of energy loss. Excitation is when an incoming particle interacts with the orbiting electrons of an atom and transfers a small amount of energy to the incident electron. In excitation, this energy transfer causes the electron to move up into a higher energy level while ionization

completely ejects the electron from the atom. Though it is rare to have a nucleon interaction, the energy transfer is much greater than in electron interactions. This large energy transfer can cause production of energetic new particles called secondary particles. Numerous processes can cause the production of secondary particles including coherent effects with the nucleus, direct knockout of nuclear components, and resonant excitation with particle emissions. These events are dependent on energy, particle type, and material [21], [19].

2.4. Radiation Dosimetry

When radiation impinges on a target nucleus, it can undergo nuclear collisions with the target or, more often, undergo energy losses by ionization or excitation of atomic electrons inside the target medium. In human spaceflight, the target that is important is human tissue. As radiation penetrates a target, it deposits energy. The amount of energy deposited by ionizing radiation per unit mass is called absorbed dose. Absorbed dose, D, is expressed in units of Gray where one Gray equals one joule per kilogram [4].

$$D = \frac{dE}{dm} \qquad (1)$$

This is where

dE is the energy imparted to the target material

dm is the mass of the target material absorbing the energy

When concerned with biological damage, absorbed dose does not tell the whole story. Radiation that has a high linear energy transfer (LET) is much more damaging to human tissue than radiation with low LET. LET is defined as rate of energy loss per unit distance travelled and usually expressed in keV/µm. This is because the energy is absorbed in a distinct trail and the small surrounding cells are damaged in this penetration. It can damage small structures including DNA. Dose equivalent (H) equals absorbed dose (D) and a quality factor, Q (i.e. H=QD). The quality factor converts absorbed dose to biological damage to the exposed tissue. Different types of radiation, such as alpha particles, are more biologically damaging to tissue than other radiation types. Using absorbed dose alone would suggest that each type of radiation does equal biological damage, which is not true [4]. The following tables, table 2 and table 3, show how LET and Q correlate.

Table 2. Dependence of Quality Factor, Q, on LET as Recommended by ICRU, NCRP, and ICRU [4]

LET, L (keV/µm in Water)	**Q**
< 10	1
10 – 100	0.32L – 2.2
> 100	$300/\sqrt{L}$

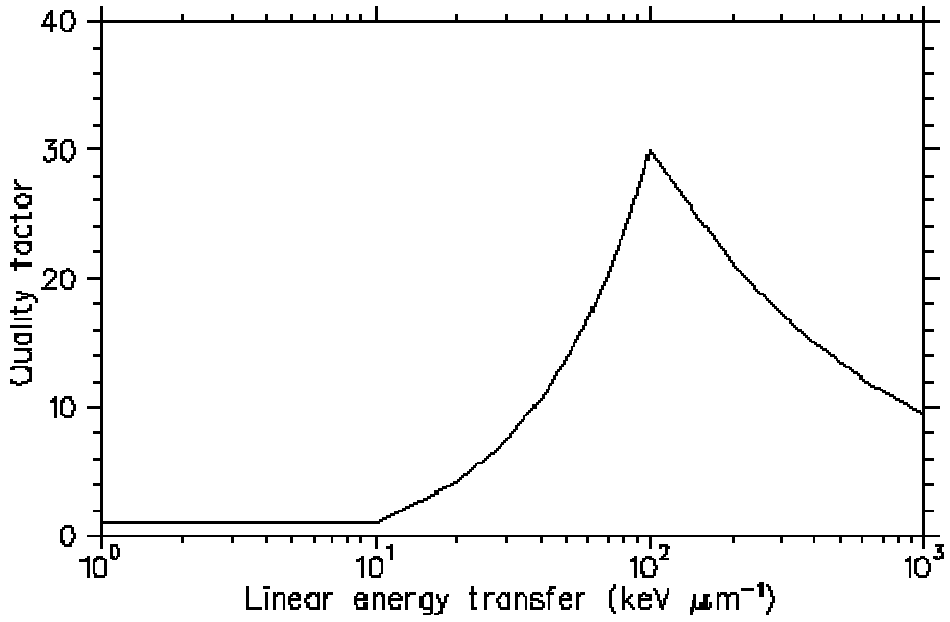


Figure 7. Correspondence between LET and quality factor [30]

Though dose equivalent paints a more accurate picture than absorbed dose for biological effects, it is not commonly used. Instead, when dealing with tissue, equivalent dose, is used. Equivalent dose is defined as the product of average absorbed dose in a particular organ by a particular radiation, and a radiation weighting factor, . The radiation weighting factor is dimensionless and depends on the type of impinging radiation and its energy [4].

$$H_{T,R} = w_R D_{T,R} \quad (2)$$

This measurement is expressed in units of Sieverts (Sv) which is equivalent to joules per kilogram.

Table 3. Radiation weighting factors [31]

Type and energy range	w_R
Photons, all energies	1
Electrons and muons, all energies[2]	1
Neutrons, energy <10 keV	5
10 keV to 100 keV	10
>100 keV to 2 MeV	20
>2 MeV to 20 MeV	10
>20 MeV	5
Protons, other than recoil protons, energy >2 MeV	5
Alpha particles, fission fragments, heavy nuclei	20

These weighting factors account for the differences in biological damage that each type of particle is capable of impinging on the tissue [32].

The following equation sums the different types of radiation to give a total value.

$$H_T = \sum_R w_R D_T \qquad (3)$$

w_R is the radiation weighting factor

D_T is the dose deposited into particular tissue

R is the type of radiation

Due to computational difficulties associated with the complex radiation fields in space, NASA uses an alternative quantity called organ dose equivalent, which involves an integral of the dose and Q over an entire organ.

$$H_T = \frac{1}{m} \int dm \int Q(L) \Phi_T(L) L dL \qquad (4)$$

m = mass of organ

Φ_T = total fluence of particles through organ

L = LET

Different parts of the body have different responses to radiation, some much more sensitive than others. To determine the effects of exposure of a particular organ or tissue to the whole body, effective dose, E, is used. E is the sum of all stochastic effects to one particular individual:

$$E = \sum w_T H_T \qquad (5)$$

w_T is the tissue weighting factor

H_T is the organ dose equivalent deposited in a particular tissue

The tissue weighting factors account for different probabilities in the occurrence of stochastic radiation effects in different organs and tissues [33].

Table 4. Tissue weighting factors [31]

Tissue or organ	w_T
Gonads	0.20
Bone marrow (red)	0.12
Colon	0.12
Lung	0.12
Stomach	0.12
Bladder	0.05
Breast	0.05
Liver	0.05
Oesophagus	0.05
Thyroid	0.05
Skin	0.01
Bone surface	0.01
Remainder	0.05[2,3]

Since effective dose takes into account the type of radiation and organ, it serves as a measure of risk to the whole body. Different types of radiation and/or organs can be compared to see their exposure risks [31].

To keep astronauts safe, NASA sets short-term and career dose limits. The short-term limits prevent any significant acute health risks while career limits are to keep the risk of cancer mortality to an acceptable level.

In the early stages, radiation effects usually happen after a large fraction of cell loss in body tissue. Deterministic effects are a function of dose. These effects

usually have a threshold level below which they will be absent. The following table, table 5, lists dose limits for preventing deterministic effects.

Table 5. Short-term dose limits [34]

Organ	30 Day Limit	1 Year Limit
Eye	1.0 Gy-Eq	1.5 Gy-Eq
Skin	2.0	3.0
BFO	0.25	0.5

For stochastic effects, severity is not a function of dose. They may or may not occur. There is no threshold energy, but the probability of occurrence increases with dose. Cancer is an example of a stochastic effect [25].

Concerning short-term effects, age and gender are unimportant since there have not been any differences observed between them. Recently, experiments have provided information that suggests cataract risks from space radiation are linear with GCR dose and have no apparent threshold. These are caused by genetic damage leading to aberrant cellular differentiation of lens epithelial cells [34]. Later effects, like cancer, are stochastic by nature. Even at low doses, some level of risk is incurred. Though NASA has had many changes to the career limits for fatal cancer, Risk of Exposure Induced Death (REID) is the current basis for career dose limits.

Table 7 shows career effective dose limits for NASA's lunar missions using the 3% REID limit. An average person has an average lifetime risk of death from cancer of ~ 23%. Extra radiation exposure to astronauts cannot exceed 3% additional risk of death from cancer above the average lifetime risk for the general population. The table also shows projection of average Life-loss for an exposure induced death for radiation carcinogenesis [34].

Table 6. Career Effective Dose Limits in mSv and Average Life Loss per year [34]

Age, yr	***Career effective dose limits in units of Sievert (mSv) for 1-year missions (Ave Life Loss in years from exposures in a 1 year mission)***	
	Males	Females
25	520 (15.7)	370 (15.9)
30	620 (15.4)	470 (15.7)
35	720 (15.0)	550 (15.3)
40	800 (14.2)	620 (14.7)
45	950 (13.5)	750 (14.0)
50	1150 (12.5)	920 (13.2)
55	1470 (11.5)	1120 (12.2)

3. THE LRO MISSION

On June 18, 2009, the Lunar Reconnaissance Orbiter (LRO) mission was launched as the first of many planned missions by NASA to prepare for future permanent human presence on the Moon and travels beyond [34]. The spacecraft orbited the Moon in a polar orbit at an altitude of 50km for a nominal one year mission in the operations phase, followed by a scientific mission of unspecified duration still currently underway. The data obtained during the scientific portion of the mission are used to provide an understanding of the lunar radiation environment in order to better equip a human return to the Moon and subsequent exploration of the solar system [19], [36]. In order to be accessible to the public, the LRO initial data sets are loaded into the Planetary Data System (PDS) within six months of the completion of the primary mission. PDS is a publicly accessible repository of planetary science information. During the secondary mission phases, the data sets are uploaded every three months.

3.1. Components of the LRO

The LRO has four main objectives: to find safe landing sites, locate potential resources, characterize the radiation environment and test new technology. The following figure shows the different instrumental components of the spacecraft [36].

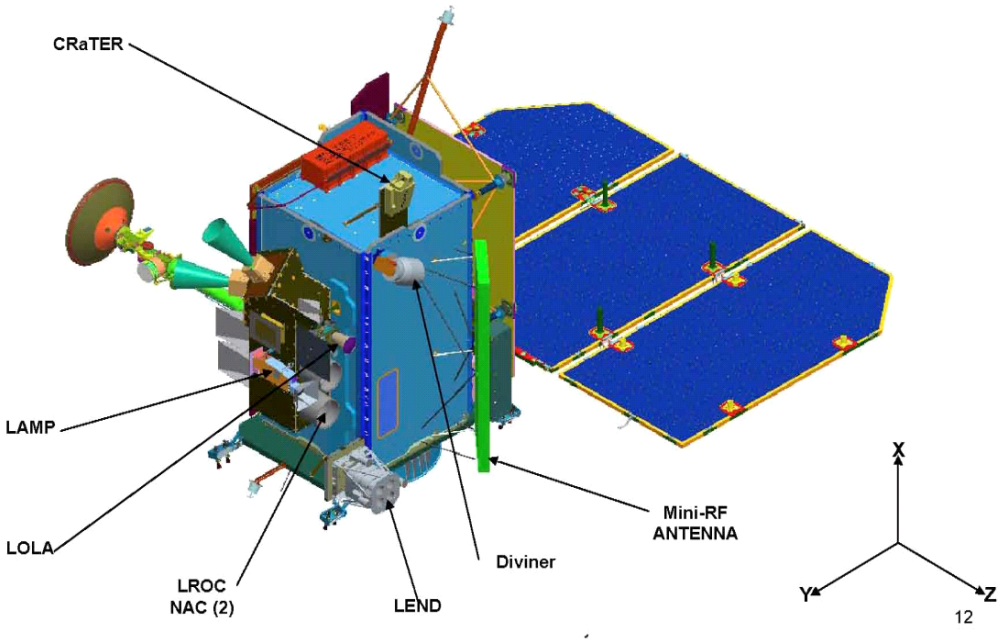


Figure 8. The Lunar Reconnaissance Orbital (LRO) configuration components [36]

Each LRO instrument contributes to the completion of the mission's objectives. The following describes each instrument's function.

CRaTER (Cosmic Ray Telescope for the Effects of Radiation) characterizes the global lunar radiation environment and its biological impacts. It also tests radiation effects on shielding materials.

DLRE (The Diviner Lunar Radiometer Experiment) measures lunar surface thermal emission for future surface operations and exploration by providing

orbital thermal map measurements and warning against landing hazards such as rough terrain and rocks.

LAMP (The Lyman-Alpha Mapping Project) looks at permanently shadowed craters (only illuminated by starlight) to discover water-ice by using ultraviolet light from stars and the interplanetary medium.

LEND (The Lunar Exploration Neutron Detector) creates hydrogen distribution maps and gives information about the lunar radiation environment. It also provides measurements, maps, and informs of possible near-surface water ice deposits

LOLA (The Lunar Orbiter Laser Altimeter) investigation displays a precise global lunar topographic model and geodetic grid for measuring landing site slopes, lunar surface roughness, and identifying permanently illuminated or permanently shadowed areas.

LROC (The Lunar Reconnaissance Orbiter Camera) addresses the measurement requirements of landing site certification and polar illumination using high resolution black and white images of the lunar surface.

Mini-RF (The Miniature Radio Frequency) radar demonstrates new lightweight synthetic aperture radar and communications technologies while locating potential water-ice with high-resolution images of permanently shadowed regions of the surface.

3.2. CRaTER Investigation

The Cosmic Ray Telescope for the Effects of Radiation (CRaTER) instrument was designed to characterize the lunar radiation environment and its biological impact in order to enable humans to return to the Moon safely for an extended or permanent manned mission. In order to characterize the lunar radiation environment, CRaTER has a goal of measuring LET spectra. CRaTER cannot directly measure LET since the particles' path lengths are unknown. Instead, CRaTER actually measures the total energy deposited and divides by the finite thickness of the detector. Although this does introduce error, CRaTER is designed to have a path length uncertainty of less than 10%. Not only is primary radiation from GCRs and SEPs a factor of concern, secondary radiation is an obstacle in the measurement process. Secondaries occur when the primary radiation undergoes a collision with the target nuclei. The particles produced (secondaries) usually have a low LET, but this addition of energy deposition clutters the detection window causing the measurement spectra to be a dependent on many factors including type, quantity, variation in incident spectra, etc [35].

The LET measurements do not include all species and/or energies. There is a possible exclusion of neutron energy deposited behind spacecraft shielding. Incoming ion energies below 10 MeV are not well known or understood because of significant variability, and therefore are not detected. Energetic ions above 10 MeV, externally impinging on the human body, are of the utmost importance because of their known damaging biological effects. Although results reveal

detected particles lower than the 10 MeV cut off energy, CRaTER was designed to detect particles at or above this threshold.

3.3. CRaTER Description

The following, figure 9, displays the CRaTER flight model.

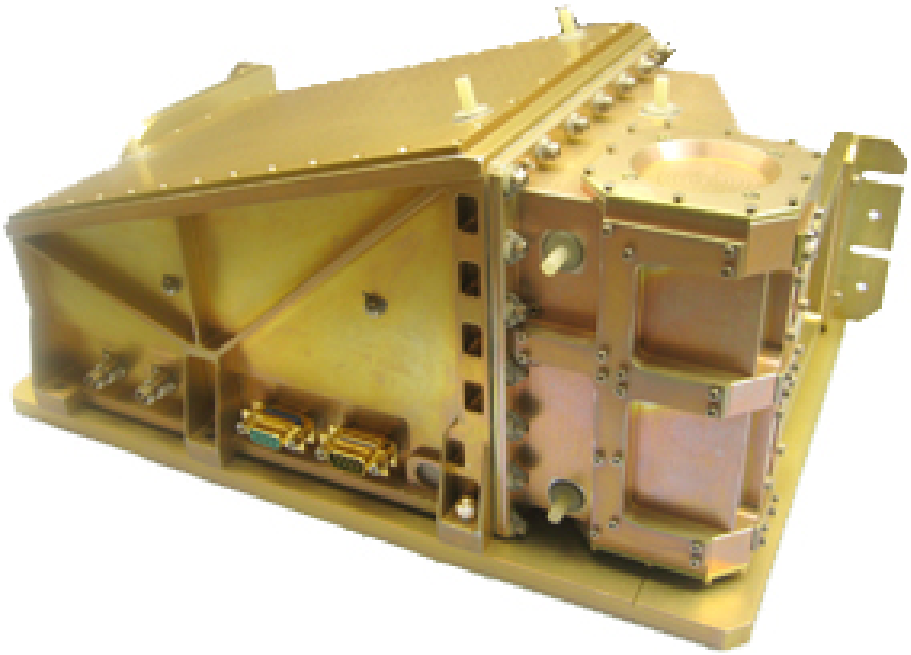


Figure 9. CRaTER flight model [35]

Figure 9 shows the actual telescope (CRaTER) assembly on the right side of the enclosure, while left side of the figure (slanted enclosure) encases the signal processing section and the spacecraft interface. The total size of this instrument is roughly 24.1 cm long, 23 cm wide, and 15.9 cm tall [35].

The following figure, figure 10, shows the internal setup of the telescope.

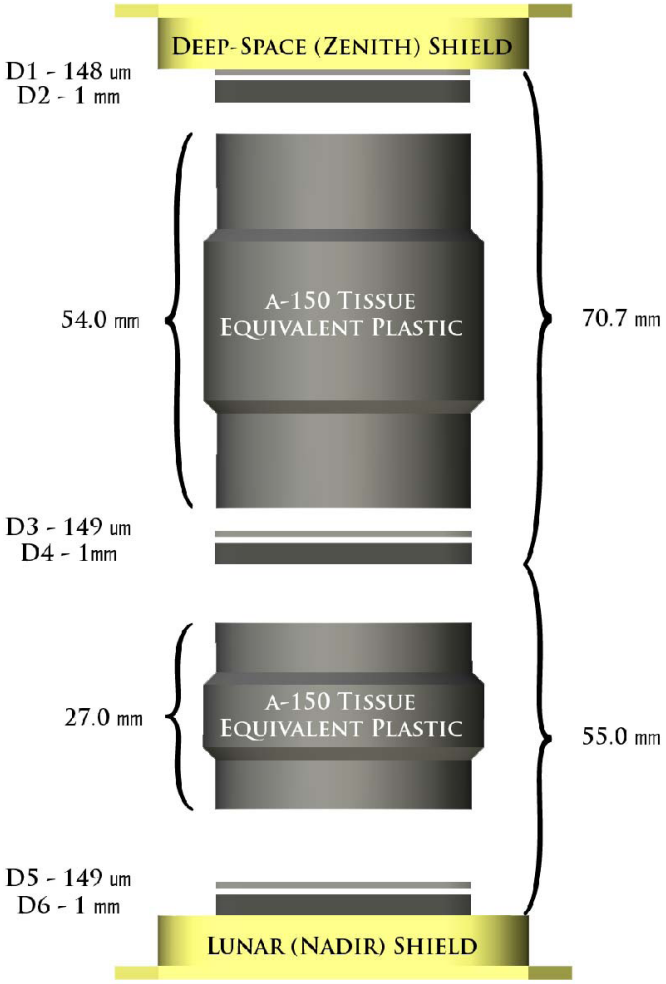


Figure 10. Schematic of the Instrument Layout [37]

The following is a table listing the exact materials and dimensions of the components of CRaTER starting at the zenith end. Also listed are the spacing voids between each component.

Table 7. Linear Dimensions of Telescope Components

Location	Material	Thickness (mm)	Cumulative distance (mm)
S1	Aluminum	0.8128	0.8128
S1 (back) □¨.D1 (front)	(void)	2.363	3.1758
D1	Silicon	0.148	3.3238
D1 (back) □¨.D2 (front)	(void)	3.36	6.6383
D2	Silicon	1	7.6838
D2 (back) □¨.T1 (front)	(void)	3.943	11.6268
A1	A-150	53.967	65.5938
A1 (back) □¨D3 (front)	(void)	3.554	69.1478
D3	Silicon	0.149	69.2968
D3 (back) □¨.D4 (front)	(void)	3.568	72.8648
D4	Silicon	1	73.8648
D4 (back) □¨.A2 (front)	(void)	11.9	85.7648
A2	A-150	26.98	112.7448
A2 (back) □¨.D5 (front)	(void)	11.9	124.6448
D5	Silicon	0.149	124.7938
D5 (back) □¨.D6 (front)	(void)	3.06	127.8538
D6	Silicon	1	128.8538
D6 (back) □¨.S2 (back)	(void)	2.362	131.2158
S2	Aluminum	0.81026	132.026

CRaTER has two open ends for incoming particles to penetrate, as shown in figure 10. The zenith end faces deep space while the nadir end faces the moon. Although the telescope can be rotated, this is the normal orientation. Starting at the zenith end, there is the first of the three silicon detector pairs. Each pair consists of a thick (for low LET particles) and a thin (for high LET particles) silicon detector in order to cover the full LET spectrum. Thin detectors map 0 – 300 MeV while thick detectors map 0 -100 MeV. Next is the thick slab of tissue

equivalent plastic (TEP). TEP consists of hydrogen, carbon, nitrogen, oxygen, fluorine, and calcium. This is for biological impact research because it serves as a human tissue surrogate, and the thicknesses of the TEP segments simulate the body self-shielding by overlaying human tissue of the blood forming organs. This plastic tissue substitute has components similar to those found in human skin and muscle. The following table gives the elemental components of A-150 (TEP).

Table 8. Mass Compositions of A-150 (TEP) [35]

Element	Mass Composition
Hydrogen	10.33%
Carbon	76.93%
Nitrogen	3.3%
Oxygen	6.93%
Fluorine	1.14%
Calcium	1.37%
Total	93.07%
Density 1.127 g/cm^3	

The end caps (zenith and nadir ends) along with the casing are made of aluminum. The following table gives the composition of the aluminum endcaps.

Table 9. Composition of Aluminum Endcaps [35]

Element	Mass Composition (%)	Use for CRaTER (%)
Aluminum	95.8 - 98.6	97.200
Chromium	0.0400 – 0.350	0.195
Copper	0.150 – 0.400	0.275
Iron	≤ 0.700	0.455
Magnesium	0.800 – 1.20	1.000
Manganese	≤ 0.150	0.075
Silicon	0.400 – 0.800	0.600
Titanium	≤ 0.150	0.075
Zinc	≤ 0.250	0.125
Other, each	≤ 0.0500	
Other, total	≤ 0.150	
Total		*100.00*
Density	2.7 g/cm3	2.7 g/cm^3

3.4. CRaTER Technology

Similar NASA instrument technologies have been operated in the past with few problems. Hence this long standing technology was used in developing the CRaTER instrument. Prior to launching LRO, CRaTER was calibrated at three different laboratories: (1) Lawrence Berkeley National Laboratory using the 88”cyclotron (beams of protons through Bi at energies up to ~30 MeV/nucleon); (2) the NASA Space Radiation Effects Laboratory at Brookhaven National Laboratory using a heavy ion beam (Iron beams up to 1 GeV/nucleon); and (3) proton beams at Massachusetts General Hospital (proton beams up to ~ 100 MeV) [38].

Each detector pair is made of silicon semiconductor crystals that are useful in detecting energy losses of ionizing radiation. Since the silicon is doped, the detector is much more sensitive than a proportional counter. The silicon is made of N-type and P-type substrate which makes it a large diode biased with little leakage current. Energetic particles pass through the silicon liberating electron-hole pairs. The passing radiation creates a current produced by the electron-hole pair. This current is directly proportional to the energy deposited [19], [35]. The following figure shows the cross section of the silicon detectors.

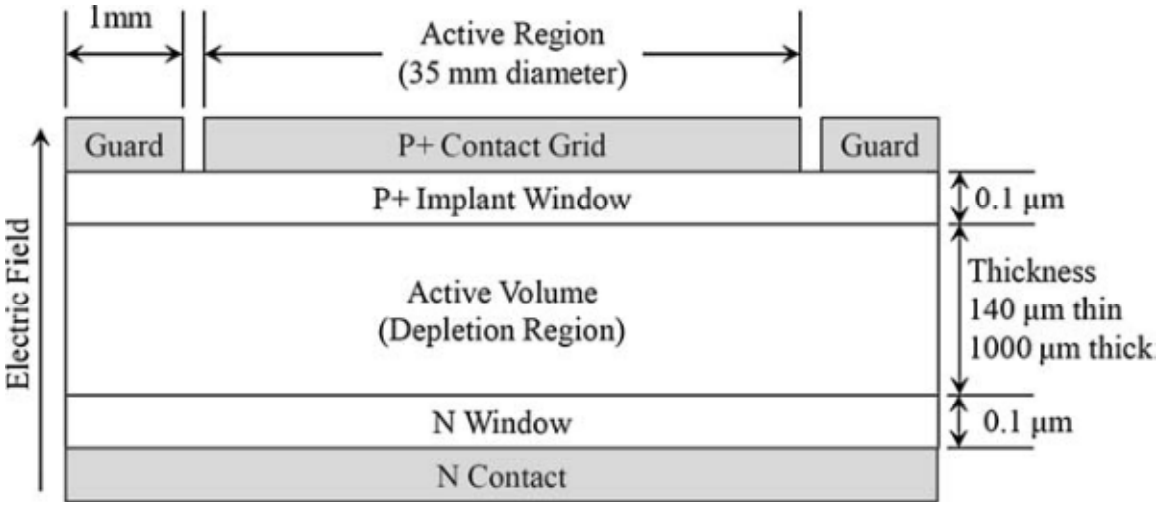


Figure 11. Schematic Cross Section of the Silicon Detectors in the CRaTER Instrument [35]

CRaTER functions as follows: A charged particle of some kinetic energy enters D1. It deposits energy by ionizing the detector components. After experiencing nuclear interactions, the primary ion produces secondary particles, which also

deposit energy. These primary and secondary particles can interact with anywhere from one to all of the detectors. Those detectors that receive sufficient energy deposition will cross the trigger threshold. Digital logic compares coincidences with an event mask of desirable events. Pulse height analysis (PHA) is conducted on each detector to measure the energy deposition. Since the length of each CRaTER component is known, the output files give LET of each and every particle for each day of the mission. It is possible that the detected particles do not come from deep space but come from the lunar surface and penetrate CRaTER from the nadir end. Simulated data comparisons, however, use the zenith field of view. The following figure shows the possible series of trajectories of incoming particles.

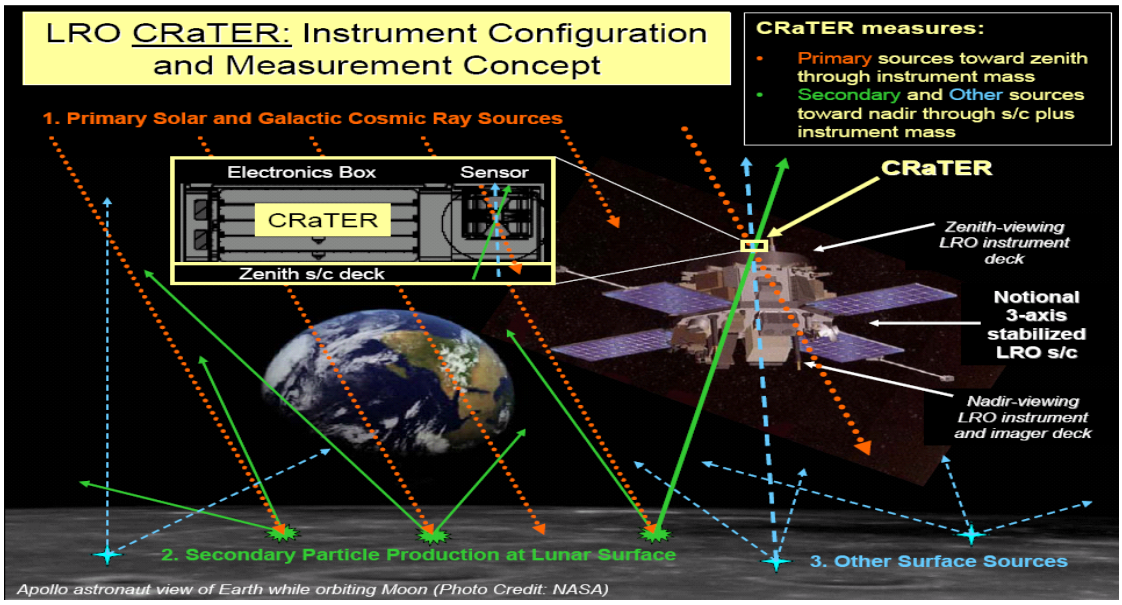


Figure 12. Possible CRaTER Particle Trajectories

3.5. CRaTER Data Analysis

CRaTER's objective is to generate the LET distribution from each penetrating particle. This means that the instrument must convert pulse height to energy deposition using analog-to-digital converters (ADC) which are electronic components that convert a voltage into a digital number (ADU). The following equation is used to determine the energy deposition, E_i, of each penetrating particle.

$$E_i = G_i C_i + O_i \qquad (6)$$

E_i is the energy deposited by the penetrating particle in the *i*-th detector in keV

G_i is the gain of the *i*-th detector in keV/ADU

C_i is the converted digital number of the pulse height in ADU

O_i is the *i*-th detector's offset in keV

These detector variables are necessary to get a true energy value for the particle. Gain is the ratio of the detector output current to the input ion current. Offset is the value that the detector is originally set from zero. Without taking these factors into account for each detector, the recorded value would not be correctly calibrated. The following table, table 11, gives the calibration factors used for each detector.

Table 10. CRaTER Calibration Factors [35]

Parameter	Units	D1	D2	D3	D4	D5	D6
Thickness	Microns	148	1000	149	1000	149	1000
Gain (G_i)	keV/ADU	76.3	21.8	78.6	21.6	76.3	21.9
Offset (O_i)	keV	105.1	50	152.8	74.7	119.1	46.6

After each energy deposition is calculated, it is divided by the length of the detector to provide the measured LET results.

$$LET = \frac{dE}{dx} = \frac{E_i}{L_i} \qquad (7)$$

E_i is the energy deposited of the penetrating particle in the *i*-th detector in keV

L_i is the length of the *i*-th detector

In order to get observed CRaTER data into a form that is comparable to simulated data, there are certain correction factors that must be applied. Depending on their incoming angle and energy, particles have different probabilities of detector penetration. These incoming angles correspond to certain geometric factors.

Table 11. Characteristics of the CRaTER Detector [38]

Low LET detectors	9.6 cm^2 circular, 1000 microns thick, 0.2 MeV threshold
High LET detectors	9.6 cm^2 circular, 140 microns thick, 2 MeV threshold
TEP absorber 1	5.4 cm length cylinder
TEP absorber 2	2.7 cm length cylinder
Zenith field of vision	35 degrees, 6 detector coincidence
Nadir field of vision	75 degrees, D3D4D5D6 coincidence
Geometry factor	0.1 cm^2 sr (D1D2 events)
LET range	0.2 - 7 MeV/micron (Si)
Incident particle energy range	> 20 MeV (H) > 87 MeV/nucleon (Fe)

In Table 11, the field of view angles (zenith and nadir) are listed. Field of view relates to penetration angles. The zenith field of view opening angle is 35 degrees, which means that any particle with an incoming trajectory angle (along the z-axis) that is 17.5 degrees or less has the opportunity to penetrate the six detectors (D1-D6). This is called a D1/D2/D3/D4/D5/D6 detector coincidence. The nadir field of view opening angle 75 degrees, which means that any particle with an incoming trajectory angle (on the z-axis) that is 37.5 degrees or less has the opportunity to penetrate the last four detectors (D3-D6). This is called a D6/D5/D4/D3 detector coincidence. The following figure is an illustration showing the field of view angles.

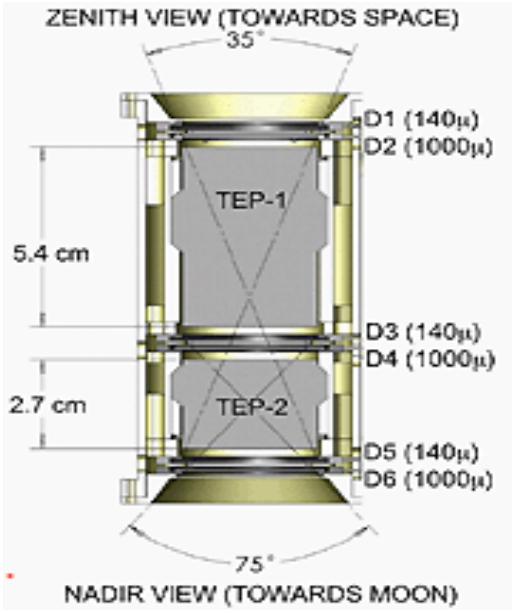


Figure 13. CRaTER Illustration Showing Field of View Angles

Table 12 displays geometric factors corresponding to particular field of view angles and detector coincidences.

Table 12. Field-of-view, geometric factors, and threshold energies of representative coincidences [35]

Representative coincidences	Field of view (full angle)	Geometric factor (cm^2-sr)	Proton threshold energy (MeV)
D1·D2	169	24.152	12.7(z)
D1·D2·D3·D4	53.4	1.679	90.8(z)
D1·D2·D3·D4·D5·D6	31.4	0.569	114.5(z)
D6·D5	170	24.566	17.7(n)
D6·D5·D4	65.9	2.564	63.9(n)

The thin detectors (D1, D3, D5) are sensitive to particles with an LET range of 2.3 keV/μm to 2.2 MeV/μm while thick detectors (D2, D4, D6) are sensitive to particles with an LET range of 0.09 keV/μm to 85 keV/μm. CRaTER has 4096 channels which results in 73.3 keV/bin for thin (140μm) and 24.4 keV/bin for thick (1000μm) detectors [19]. Since the threshold energies for the thick detectors are lower than for the thin detectors, the D2/D4/D6 detector coincidence is used. Table 13 contains additional Geometric factors calculated by the CRaTER team.

Table 13. Representative Coincidences and Geometric Factor obtained from CRaTER Team [39]

Representative coincidences	Geometric factor (cm^2-sr)
D1	29.97
D1·D2·D3	1.872
D1·D2·D3·D4·D5	0.602
D2·D3·D4	1.861
D2·D3·D4·D5·D6	0.605

CRaTER produces many levels of data. The following table explains which levels correspond to which type of output.

Table 14. CRaTER Data Level Definitions [19], [37]

Data Level	Description
Level 0	Unprocessed instrument data (pulse height at each detector, plus secondary science) and housekeeping data.
Level 1	Depacketed science data, at 1-s resolution. Ancillary data pulled in (spacecraft attitude, calibration files, etc.)
Level 2	Pulse heights converted into energy deposited in each detector. Calculation of Si LET
Level 3	Data organized by particle environment (GCR, foreshock, magnetotail). SEP-associated events identified and extracted.
Level 4	Calculation of incident energies from modeling/calibration curves and TEP LET spectra

4. TRANSPORT CODES

In order to plan future missions, there needs to be reliable radiation prediction models that are validated with the observed data from CRaTER. In this work, we compare simulations using the HETC-HEDS (High Energy Transport Code – Human Exploration and Development in Space) computer code and HZETRN (high-charge-and-energy transport) code to CRaTER's observed data. In order to compare and contrast these two transport codes with observed data, we use input GCR spectra from the Badhwar-O'Neill galactic cosmic ray model, which was developed and used by NASA. This chapter will provide a discussion of each code.

4.1. Badhwar-O'Neill Model

In order to compare our simulated results we the data, we need to know the energy, type, and number of particles for the incident GCR spectrum for the period of time in which data were acquired by CRaTER. The Badhwar-O'Neill model produces GCR energy spectra for each element [16]. The first Badhwar-O'Neill GCR model was developed in the 1990's based on balloon and satellite data from 1954 to 1992. In August 1997, the Cosmic-Ray Isotope Spectrometer (CRIS) on the Advanced Composition Explorer (ACE) spacecraft provided a significant improvement in accuracy for the GCR energy spectra by increasing the geometric factor from < 10 cm^2-sr (previous satellite instruments) to 250 cm^2 – sr. After updating with the new ACE data, the revised Badhwar – O'Neill model

provides improved and more accurate GCR environmental data for radiation protection use in determining shielding and risk estimates for astronauts and radiation hardness assurance for electronic equipment. Estimates in uncertainties for energy spectra from CRIS are less than 5%.

The Badhwar-O'Neill model accounts for solar modulation of the relevant elements, hydrogen through nickel, by propagating the Local Interplanetary Spectrum (LIS) of each element through the heliosphere. This is done by solving the Fokker – Planck diffusion, convection, energy loss boundary value problem. The deceleration parameter, $\Phi(t)$, describes the solar cycle modulation level and determines the GCR energy spectrum for all of the elements at a certain distance from the sun [40].

GCR energy and intensity when entering the heliosphere is lowered by scattering effects from irregularities in the interplanetary magnetic field embedded in the solar wind. It has been shown (Parker (1965)) that the steady state, spherically symmetric Fokker-Planck equation accurately accounts for diffusion, convection, and adiabatic deceleration of these relevant particles. The Fokker-Planck equation numerically propagates the LIS for each element to a given distance (radius) from the sun.

K(r, t), the single diffusion coefficient, describes the effect of the sun's magnetic field on particles entering the heliosphere.

$$K(r,t) = \frac{\left(\frac{K_0}{V_{SW}}\right)\beta P\left[\frac{r}{r_0}\right]^2}{\Phi(t)} \qquad (8)$$

$\boldsymbol{V_{SW}}$ is the constant solar wind speed (400 km/s)

$\boldsymbol{r}$ is the distance from the sun in Astronomical Units (AU)

$\boldsymbol{t}$ is time in years

$\boldsymbol{K_0}$ is constant

$\boldsymbol{\beta}$ is particle speed relative to the speed of light

$\boldsymbol{P}$ is particle rigidity in MV

$\boldsymbol{\Phi(t)}$ is the solar modulation parameter which describes the current state of the sun's ability to modulate cosmic rays

This diffusion coefficient describes effects of a stronger magnetic field, higher magnetic disturbances, and a magnetic field in expansion. Since it is dependent on the magnetic field, it is closely related to solar activity.

The Badhwar-O'Neill 2010 model [41] produces GCR energy spectra, in units of #ions/m^2/sr/s/MeV/n versus energy in MeV/n, with energies ranging from 1 to 10^{12} MeV/n for elements hydrogen to plutonium. The LIS is propagated to one astrological unit (AU) solving the Fokker–Planck equation for a given Φ(t). In order to choose the appropriate Φ(t), the user has to choose either to input the Φ(t) value or, if Φ(t) is unknown, to enter a date which the model uses in

determining the $\Phi(t)$ value. The user must also input: (1) the chosen element's charge number; (2) the period of time over which to average $\Phi(t)$ using interpolation from known values. The output produces the modulated GCR energy spectra for that specific element and $\Phi(t)$ or dates entered [40]. Since the units of the output flux are #ions/(m^2 sr s MeV/n), conversion factors are used to put the units into the proper form for comparison with CRaTER output data. A factor of 10^{-4} is used to convert flux units to cm^2. Seconds, s, are converted to days for the duration of our data comparison. The following figure, Figure 14, shows Badhwar-O'Neill 2010 GCR energy spectrum for select ions for a Φ value of 509.8514 which is the average Φ for the year of 2010.

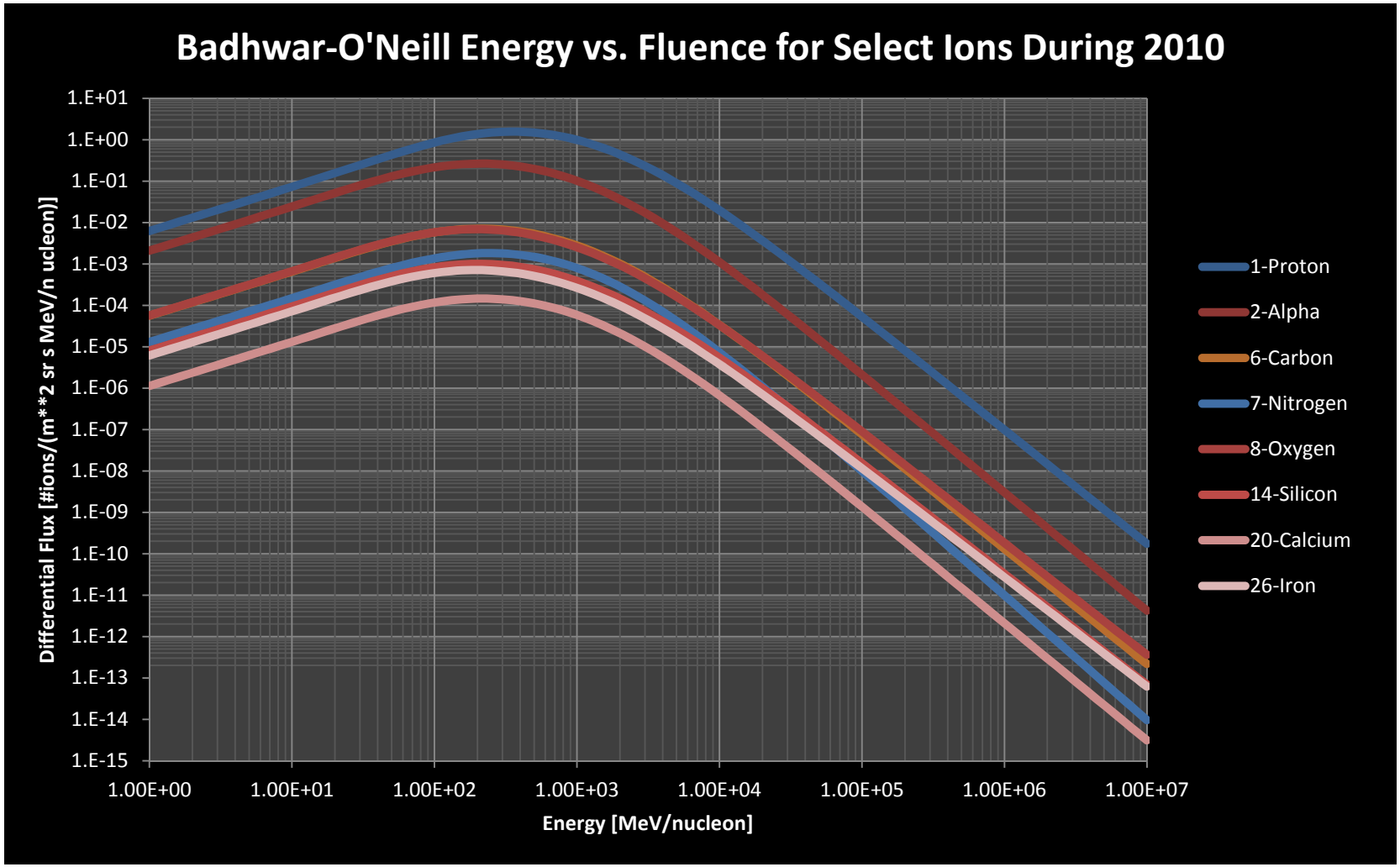


Figure 14. Badhwar O'Neill 2010 GCR Energy Spectrum for Selected Ions During Year 2010

4.2. HETC-HEDS Code

HETC-HEDS (High Energy Transport Code – Human Exploration and Development in Space) is a three dimensional Monte Carlo transport code (not yet publicly released). HETC-HEDS simulates particle cascades to compute the trajectories of the primary particle and all the secondary particles produced in nuclear collisions. A material file (in this case CRaTER) is modeled using dimensions, densities, and materials. The user provides the initial angle, energy, and particle type of the incoming ion. Using all these inputs, HETC-HEDS uses this information to simulate the track of the primary particle. If any secondary particles are produced by interactions with target materials, they are also tracked and recorded. Each particle is followed until it escapes the system, undergoes an interaction, decays or comes to rest from energy lost. HETC-HEDS provides a complete history file of all data on every particle. Neutrons produced below the specified cutoff energy and photons are not transported. The neutron spectra are saved in an output file for possible transport using neutron transport codes such as MORSE [2] or MCNP [3].

The Bethe stopping power equation, based on a continuous slowing down approximation over any finite path length, treats the excitation and ionization reactions for light and heavy ions, protons, charged pions, and muons. The continuous slowing down approximation can be used because the mass difference between orbital electrons and an incoming ion is so great that only a

small amount of energy can be transferred in a single collision [21]. Equation 8 presents the Bethe formula for the stopping power for a charged particle:

$$-\frac{dE}{dx} = \frac{4\pi k_0^2 Z^2 e^4 n}{mc^2\beta^2} \ln\left(\frac{2mc^2\beta^2}{I(1-\beta^2)} - \beta^2\right) \qquad (9)$$

k_0 is equal to 8.99×10^9 Nm^2C^{-2}

Z is the effective charge of the incident heavy particle

e is the magnitude of the electron charge

n is the number of electrons in the medium

m is the electron rest mass

c is the speed of light in a vacuum

β (v/c) is the speed of the particle relative to ***c***

I is the mean excitation energy of the medium

For this work, unrestricted stopping power ($\frac{dE}{dx}$)is equal to LET_∞. It is often assumed all energy lost by the incoming ion is absorbed in the target material with no energy losses due to delta rays escaping [4]. Looking at equation 8, it is clear that LET_∞ is dependent on *Z* and *β*. There is a positive relationship between LET_∞ and *Z* meaning when the *Z* of the incoming particle increases, which denotes a heavier ion, the LET_∞ increases. LET_∞ also increases for a particular incident ion type as the target ion's mass and charge is increased. As *β* increases, this means an increase in speed, then LET_∞ decreases giving them an inverse relationship.

Range straggling is taken into account by computing tables for protons for each material in the system. Though range straggling is not much for heavy charged particles, it is still considered. The proton tables are also used for nuclei with mass number A > 1 and for charged pions and muons using scaling methods. HETC-HEDS only allows multiple Coulomb scattering for the primary charged particles [4].

HETC-HEDS pion production is based on the isobar model of Sternheimer and Lindenbaum [41]. Only single- and double-pion production in nucleon-hydrogen collisions and single-pion production in pion-nucleon collisions are accounted for. The intranuclear-cascade evaporation concept of particle-nucleus interaction is used for energies up to 3.5 GeV for neutrons and protons and up to 2.5 GeV for charged pions. The nonelastic nucleon collisions with hydrogen > 3.5 GeV and charged-pion collisions with hydrogen at energies > 2.5 GeV are both treated by using methods that utilize experimental data for the total nonelastic n-p, p-p, $\pi^+ - p$, and $\pi^- - p$ cross sections and analytic fits to experimental data[9]. Each collision record conserves energy and number of nucleons. Neutrino production from decay is ignored. Charged-pion decay is taken into account using the known pion lifetime. Although the energy, direction, and location of neutral pions are included in the code output, any neutral pions are assumed to decay into two photons at their points of origin and are not transported. Any muon decay is accounted for using the known muon lifetime. If a muon comes to rest, it is assumed to decay immediately. Information from electron, positron, and neutrino production from muon decay is not calculated [19].

Nuclear collisions are broken into two parts, one for fragmentation and one for elastic scattering. Fragmentation is then again separated into two parts, one for choosing the ion fragment and the other selecting for its corresponding energy and direction. When a target fragmentation occurs, its outgoing quantities are determined by interchanging the target and projectile. Fragments produced in non-elastic collisions are determined by using a semi-empirical model to calculate heavy ion (lithium or heavier) fragment production cross sections [43]. Alpha fragmentation has been parameterized, and equations for helium-3, triton, and deuteron production cross sections taken from NASA TP 3285 [44]. Outgoing energy of the fragmentation products is determined using a microscopic model that estimates energy degradation [45]. The momentum distribution of nuclei fragmentation products is isotropic in a rest frame moving with nearly the primary nuclei velocity. The momentum distribution of target fragmentation products is isotropic in a rest frame almost at rest [1].

Elastic collisions for protons and heavier ions are treated differently. Proton and pion elastic collisions with all nuclei other than hydrogen are neglected because of their minimal impact. Elastic collisions for ions heavier than protons ($Z>1$) with target nuclei use cross sections obtained from an optical model derived by quantum multiple scattering theory. Then the angular dependence is determined using a Fraunhofer approximation. Neutron elastic collisions are marked with a cutoff energy. Any neutron below that energy will not be tracked but its information is written to another file for further analyses, if desired [2].

4.3. HZETRN

HZETRN (high-charge-and-energy transport) was created to address the problems of free-space radiation transport and shielding [17]. HZETRN is based on a using a straight-ahead approximation for a one-dimensional formulation of the Boltzmann transport equation. A continuous slowing-down process is substituted for long-range Coulomb force and electron interaction. Bethe's theory is used to calculate atomic (electronic) stopping power coefficients for energies above a few MeV using a scaling approximation with proton stopping power. This allows significant numerical simplification. Further detail is discussed in [17]. A Ramsauer formalism is used to obtain total cross sections, while fits to quantum calculations obtain nuclear absorption cross sections. A semi-empirical abrasion-ablation fragmentation model calculates the nuclear fragmentation cross sections. HZETRN requires input information regarding: (1) shielding material; (2) shield thickness; and (3) radiation environment. The output gives fluxes, doses, alternate risk estimates, and most importantly in our case, LET. Each shielding material is modeled separately by its mass number, charge, and number density. These input data are used to produce cross sections for the particular material. Shield thickness is only needed if modeling slabs. Each thickness of material serves as an evaluation point for the output spectrum. Lastly, the user must identify the radiation environment to use. If the environment does not already exist, the energy spectra for each ion can be manually added. For a more detailed understanding of HZETRN inner workings and benchmarking, please refer to [17] and [46].

5. COMPUTATIONAL METHODS

Each set of data, simulated and observed, must be converted into the same form for comparison purposes. Since each data set has a different original form, different methods are used to treat each. HETC-HEDS and HZETRN both use GCR spectra input from the Badhwar-O'Neill galactic cosmic ray model to compare to observed CRaTER data. This chapter describes methodology used to get the prediction simulated data.

5.1. Observed CRaTER Data

For this research, we are interested in events that agree with the following constraints: (1) the nadir end of the detector must be ≤1º from perpendicular to the moon; (2) the pulser amplitude flags, lower level discriminator (LLD) settings, and event masks must be at their appropriate levels; and (3) the pulse height analyses output must be at a minimum value of 7 ADU to trigger a relevant event.

The detector orientation is information given in the "spice file." Each day has its corresponding "spice file" which list the angle between the detector boresight and nadir views. Each day is given a name using its numerical occurrence in the year. For example, January 28, 2010 would be named 2010028. If the "spice" file for the day 2010028 is ≤1º, criteria (1) is satisfied and we look to examine constraint (2).

The pulser, LLD, and event mask data is located in the “secondary science” file. Each day has a “secondary science” file that keeps records for every second of that day. Table 15 gives the criteria necessary for each second to pass the second constraint.

Table 15. Pulser, LLD, and Event Mask Settings

Pulser Amplitude – Low Range	0
Pulser Amplitude – High Range	0
LLD Setting – Thin Detector	00071
LLD Setting – Thick Detector	00071
Discriminator Accept Mask (part 1)	4294967295
Discriminator Accept Mask (part 2)	4294967295

The last, (3), constraint used the day’s “primary science” file. This file is one second off track from the secondary science file. This means that the first second’s data in the “primary file” actually corresponds to last second of the prior day’s “secondary file”. The secondary file gives the constraints of the upcoming second, not the one it is numbered as. This offset must be taken into account when accepting/rejecting data. The PHA output for D2, D4, and D6 must be ≥ 7 ADU to trigger a real event. This process provides us the D2/D4/D6 coincidences. These ADU values are converted to energy deposition and the flux multiplied by the D2-D6 geometric factor as described in Chapter 3.

5.2. HETC-HEDS

One important aspect of the present study is to correct the previous LET look up tables by separating the primary and secondary energy depositions in each of the CRaTER components using HETC-HEDS to see if there is an improvement in the location of ion peaks and any additional changes that need to be made. For the purpose of this research, GCRs with Z = 1-26 are input for different increments of incoming energy and angle. Each component (including void gaps and endcaps) of the CRaTER detector are modeled with the exact dimensions and materials of the CRaTER detector. The field of view angle (35º) is the largest possible angle where complete penetration is possible. In previous work [18], all particles were assumed to enter through D1 parallel to the detector axis. In this work, each ion of the GCR spectrum is simulated using 100,000 particle histories at the following energy increments:

- 20-100 MeV/nucleon (in 5 MeV/nucleon increments)
- 100-200 MeV/nucleon (in 10 MeV/nucleon increments)
- 200-1000 MeV/nucleon (in 100 MeV/nucleon increments)
- 1000-3000 MeV/nucleon (in 250 MeV/nucleon increments)

The energy lost per path length of material by primary and secondary particles separately for each component of CRaTER is calculated by the following:

$$Average\ LET = \sum_{i=1}^{n} \frac{(E_{initial} - E_{final})_i}{n\,L} \qquad (10)$$

i is the primary/secondary particle

n is the number of primary particles (100,000 for this work)

L is the length of the component

$E_{initial}$ is the energy of particle ***i*** (primary/secondary) when it enters the component

E_{final} is the energy it has when it leaves the component or comes to a complete stop inside the component

Figures 15 - 26 show examples of HETC-HEDS simulated data giving LET (average) vs. Incoming Ion Energy for protons and iron.

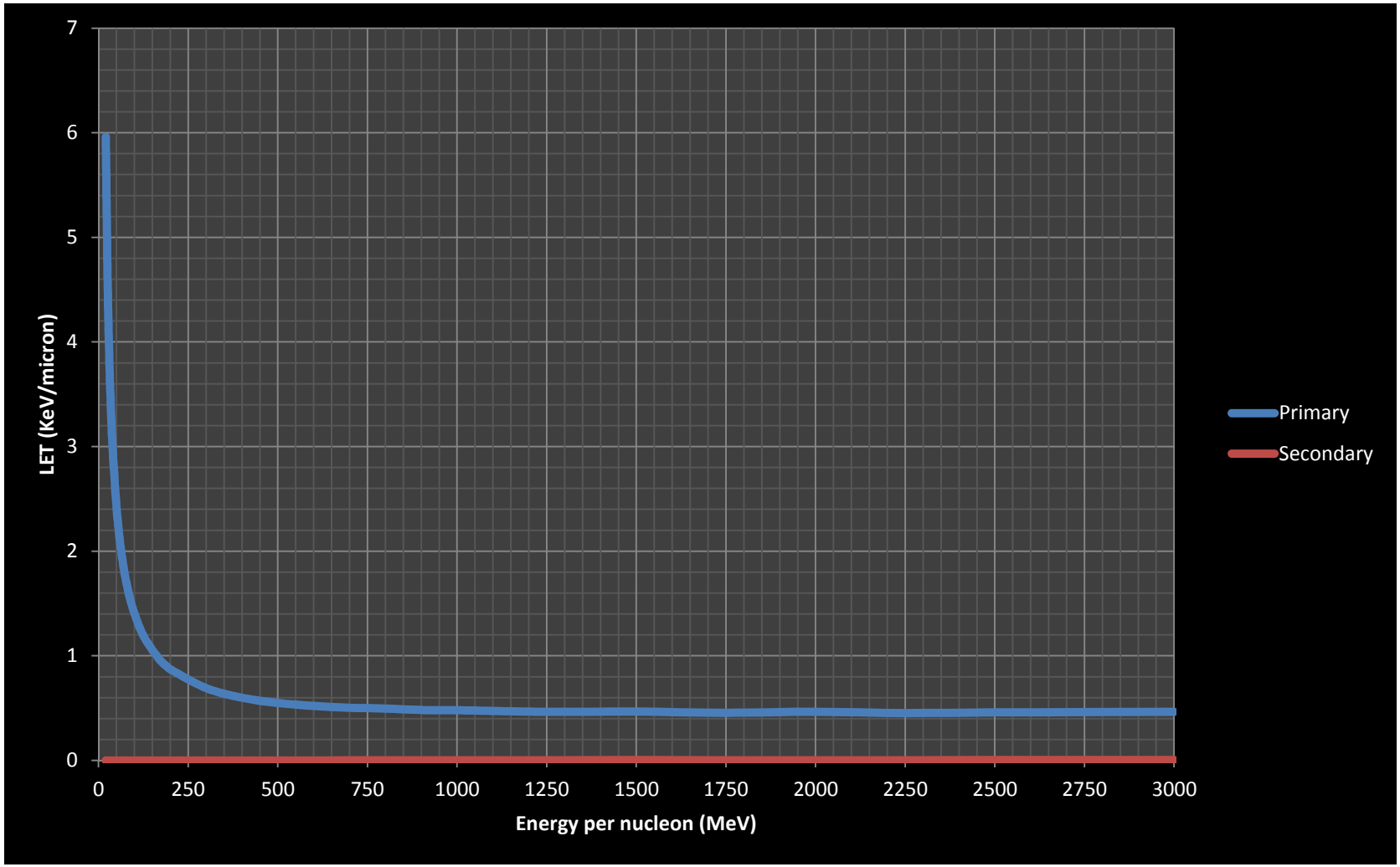


Figure 15. Proton LET vs. Incoming Ion Energy for Detector 1

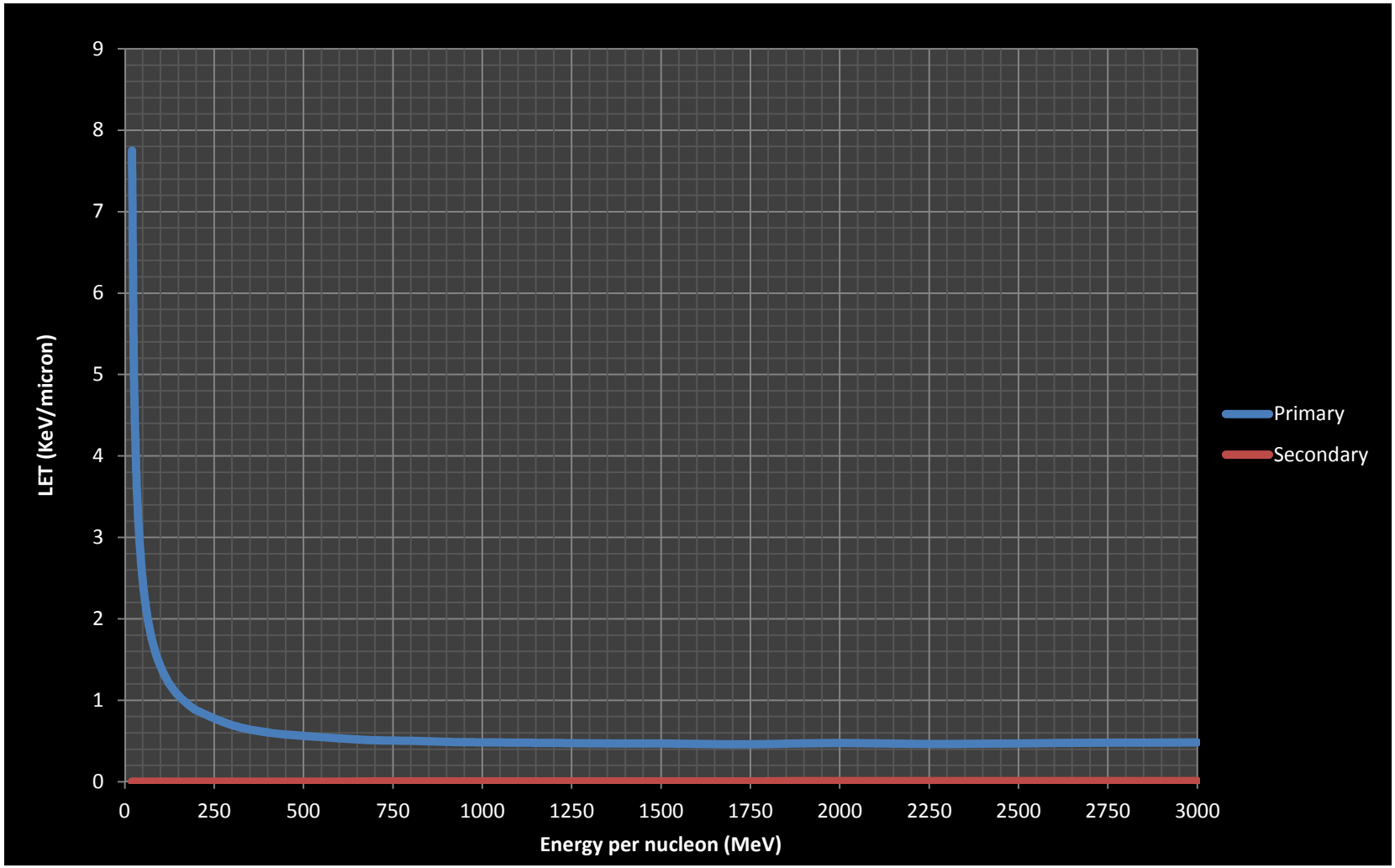


Figure 16. Proton LET vs. Incoming Ion Energy for Detector 2

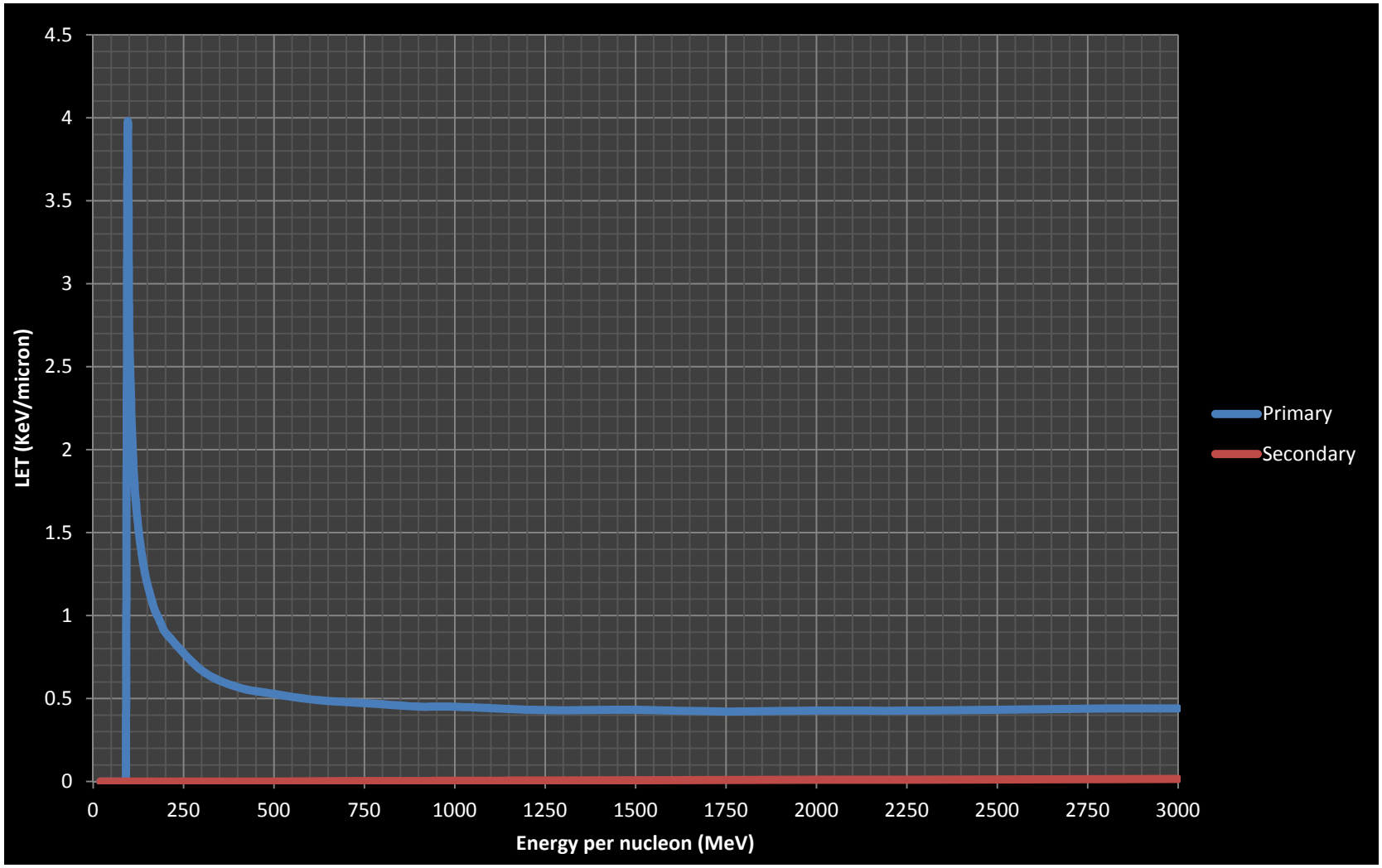


Figure 17. Proton LET vs. Incoming Ion Energy for Detector 3

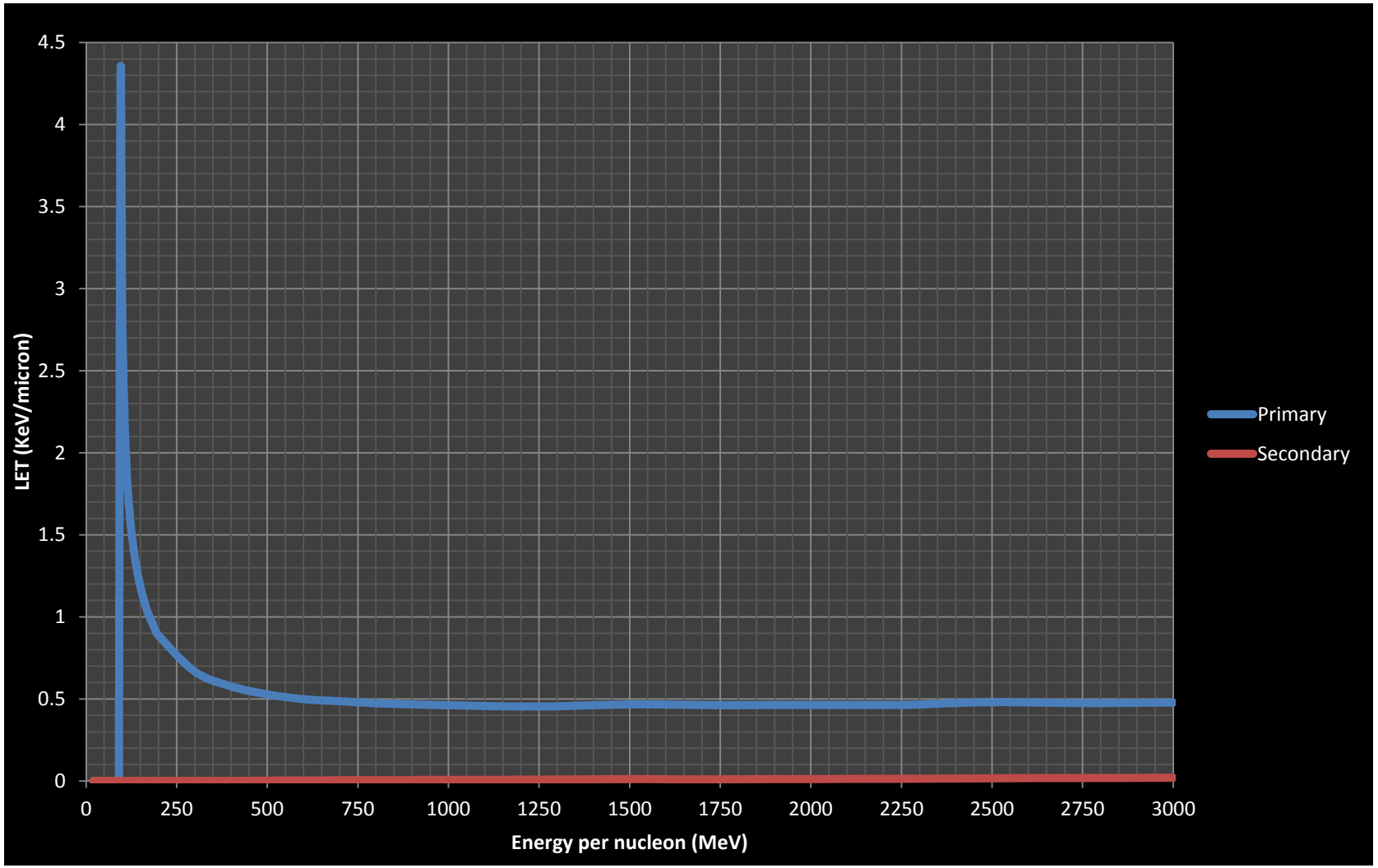


Figure 18. Proton LET vs. Incoming Ion Energy for Detector 4

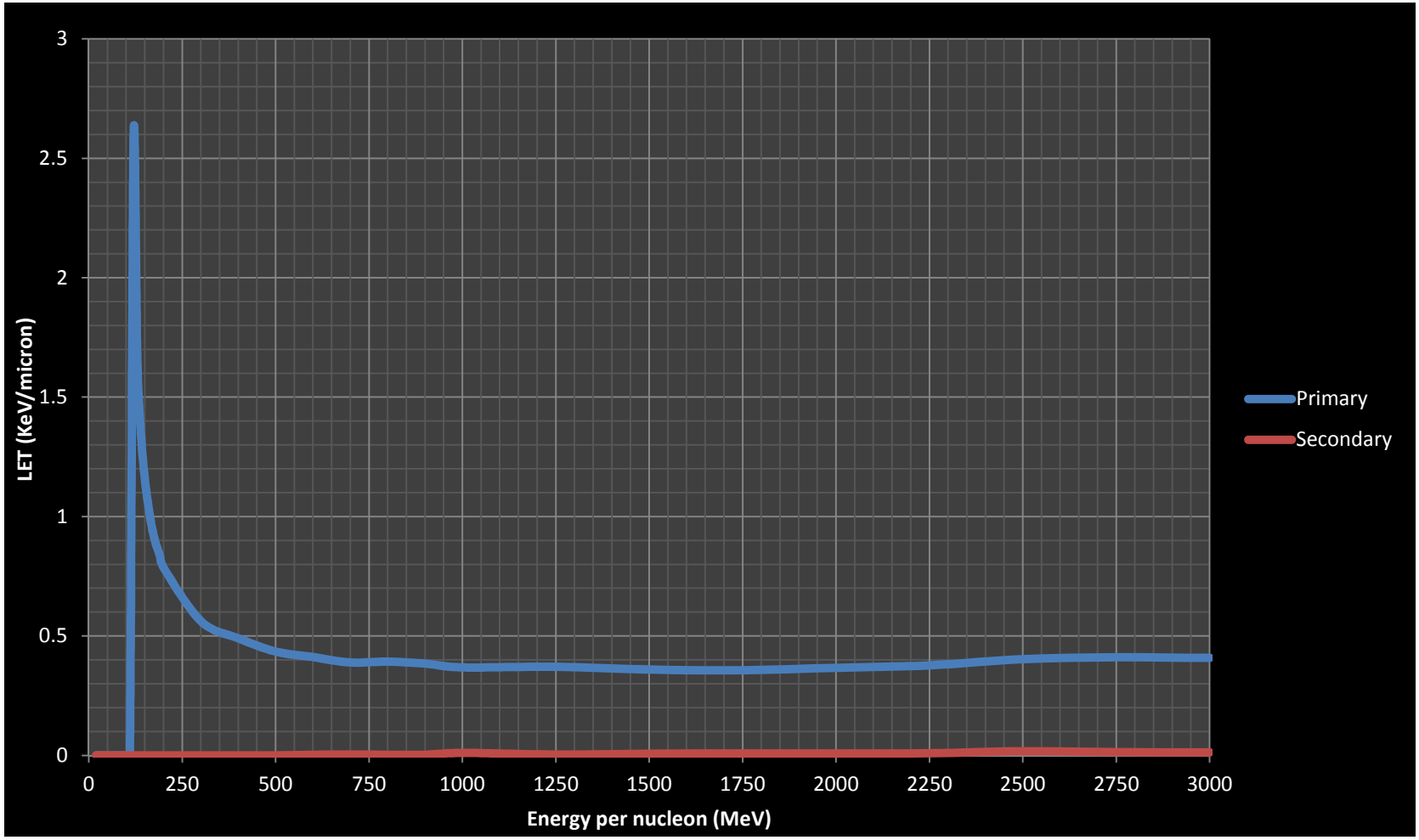


Figure 19. Proton LET vs. Incoming Ion Energy for Detector 5

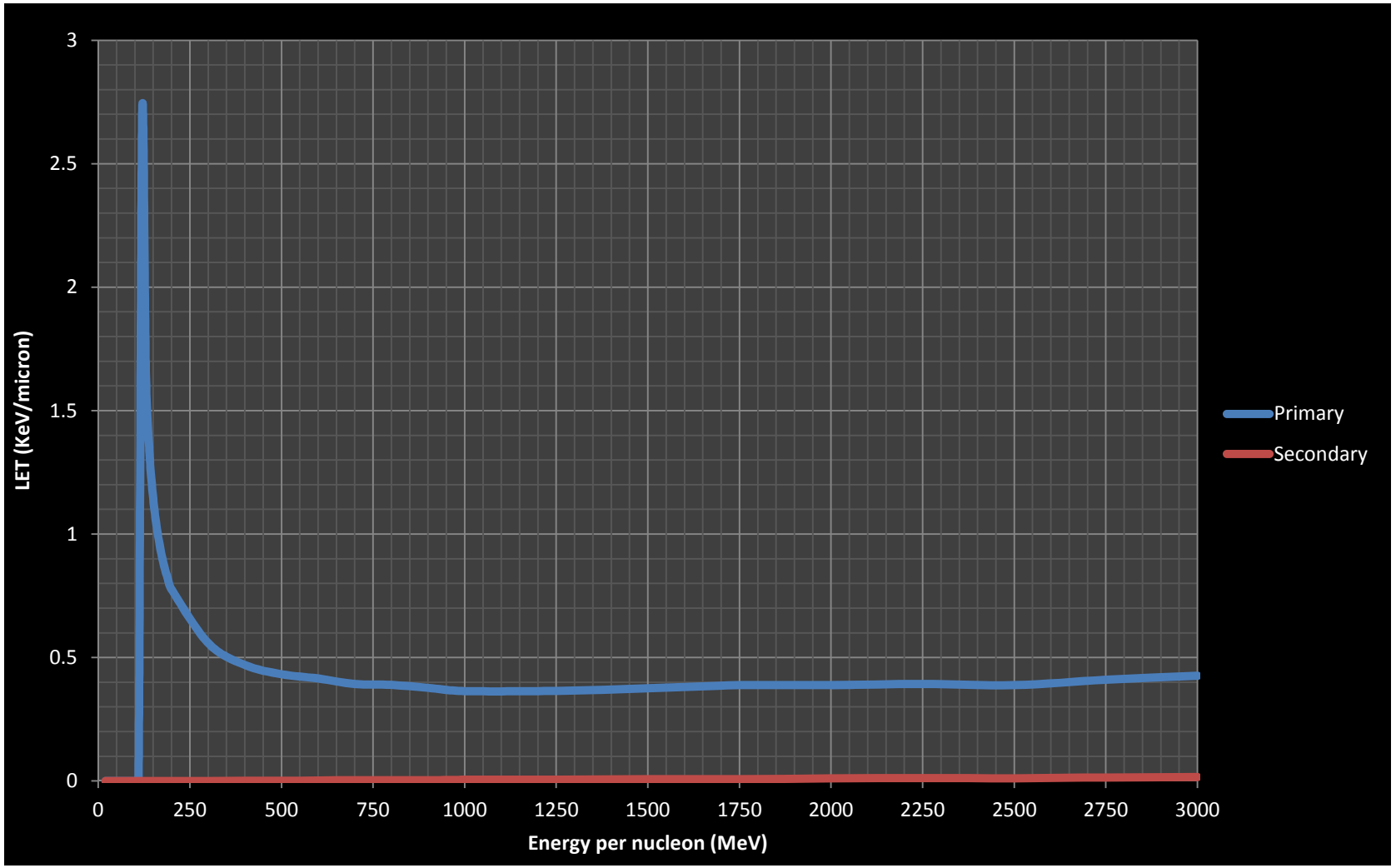


Figure 20. Proton LET vs. Incoming Ion Energy for Detector 6

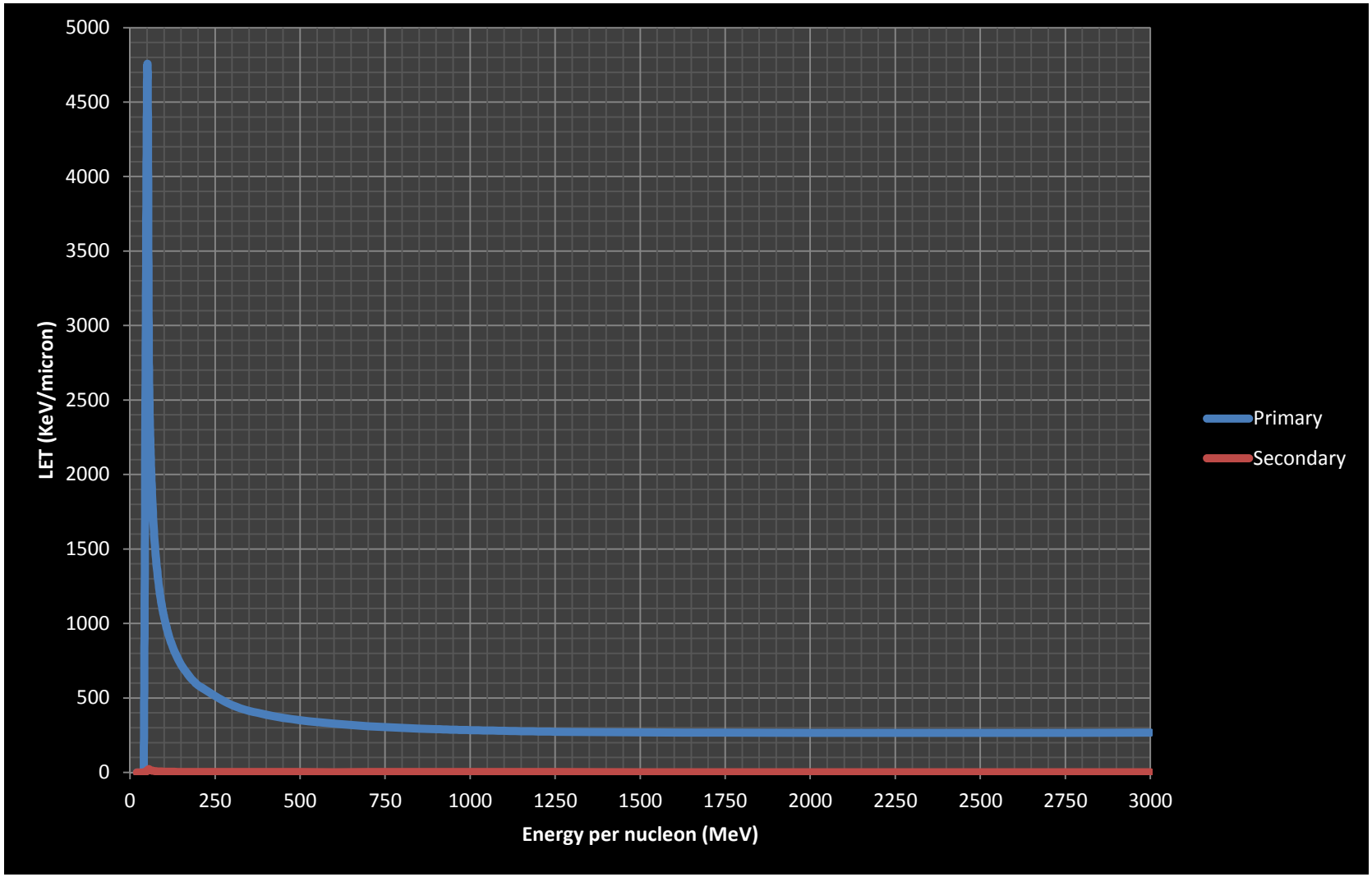


Figure 21. Iron LET vs. Incoming Ion Energy for Detector 1

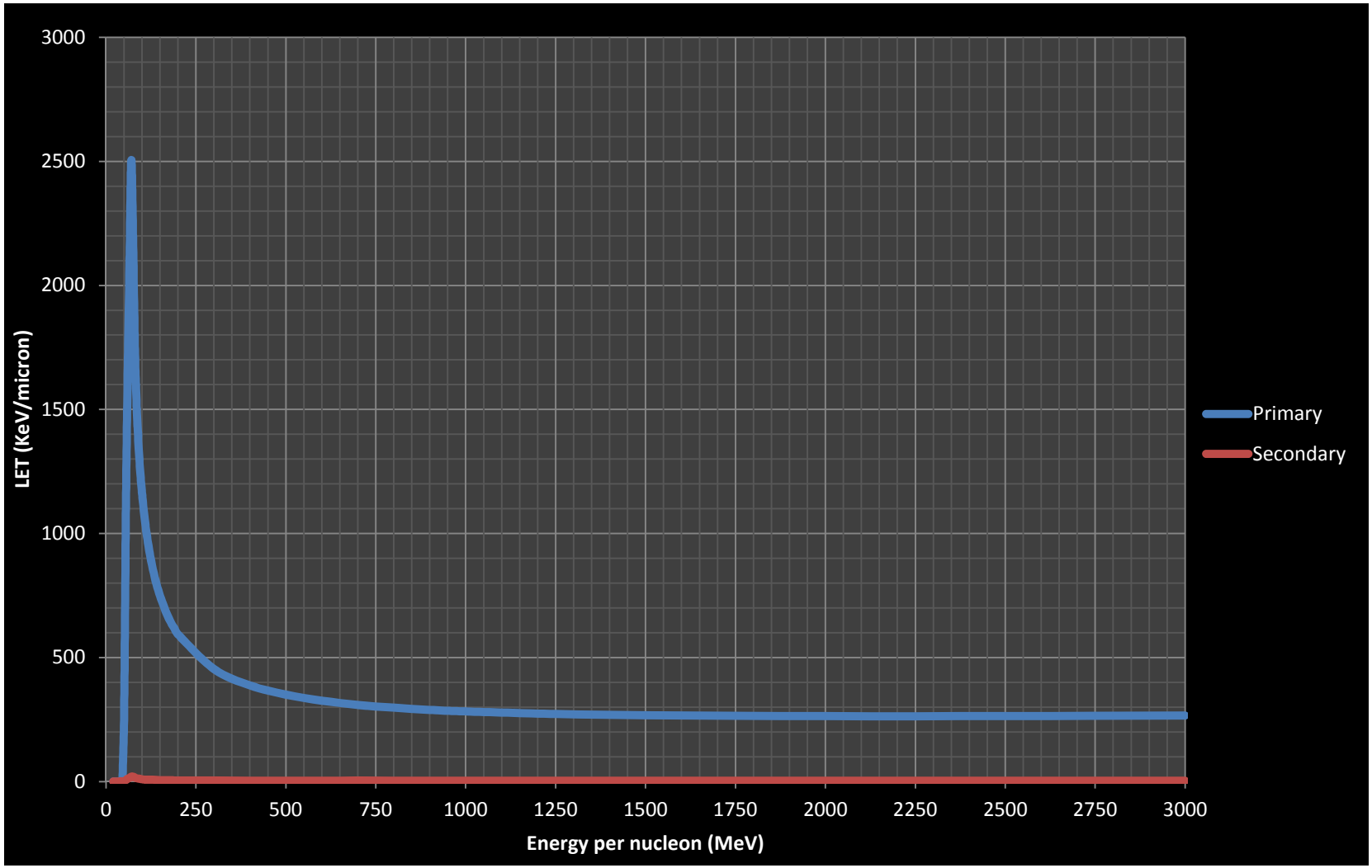


Figure 22. Iron LET vs. Incoming Ion Energy for Detector 2

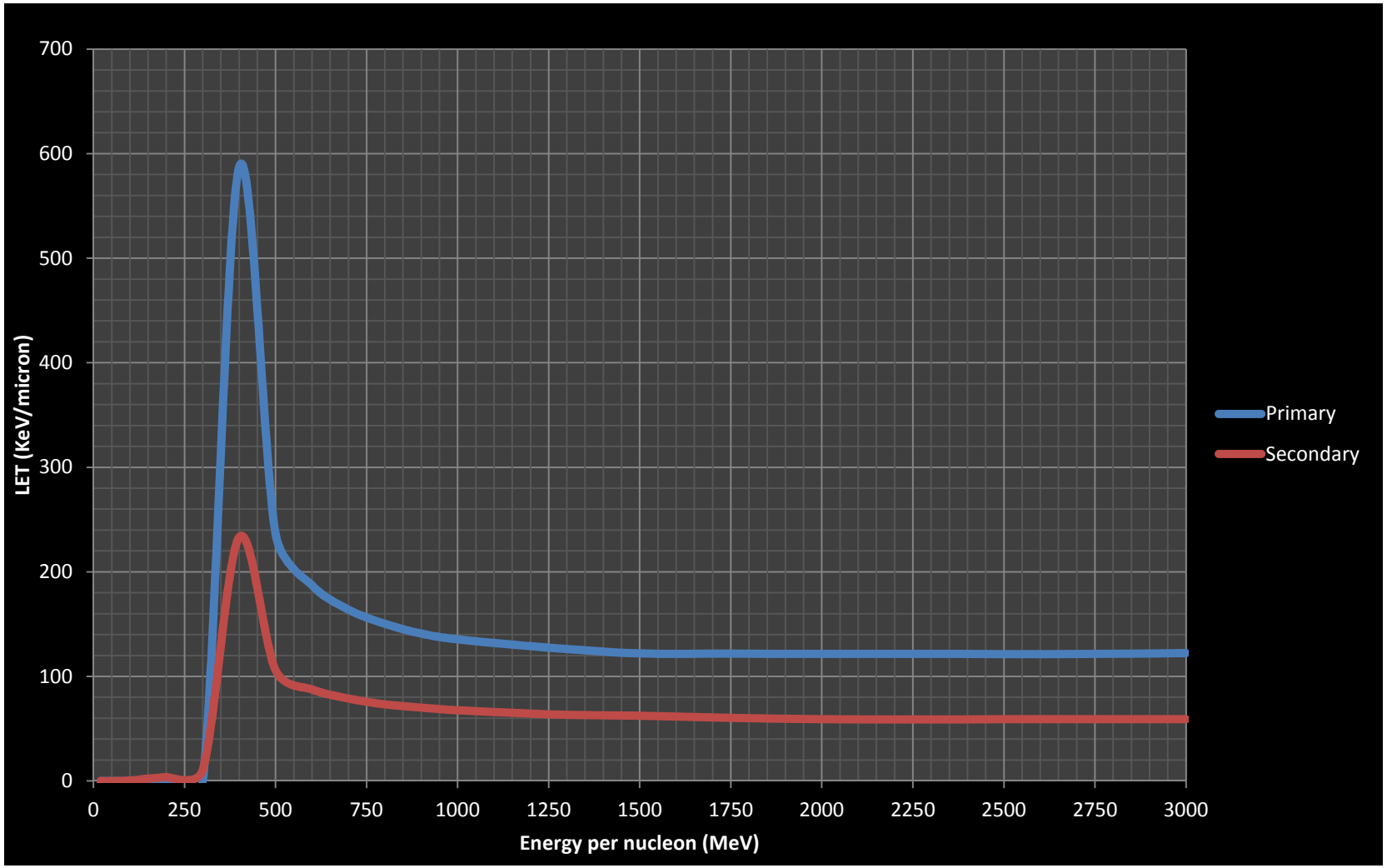


Figure 23. Iron LET vs. Incoming Ion Energy for Detector 3

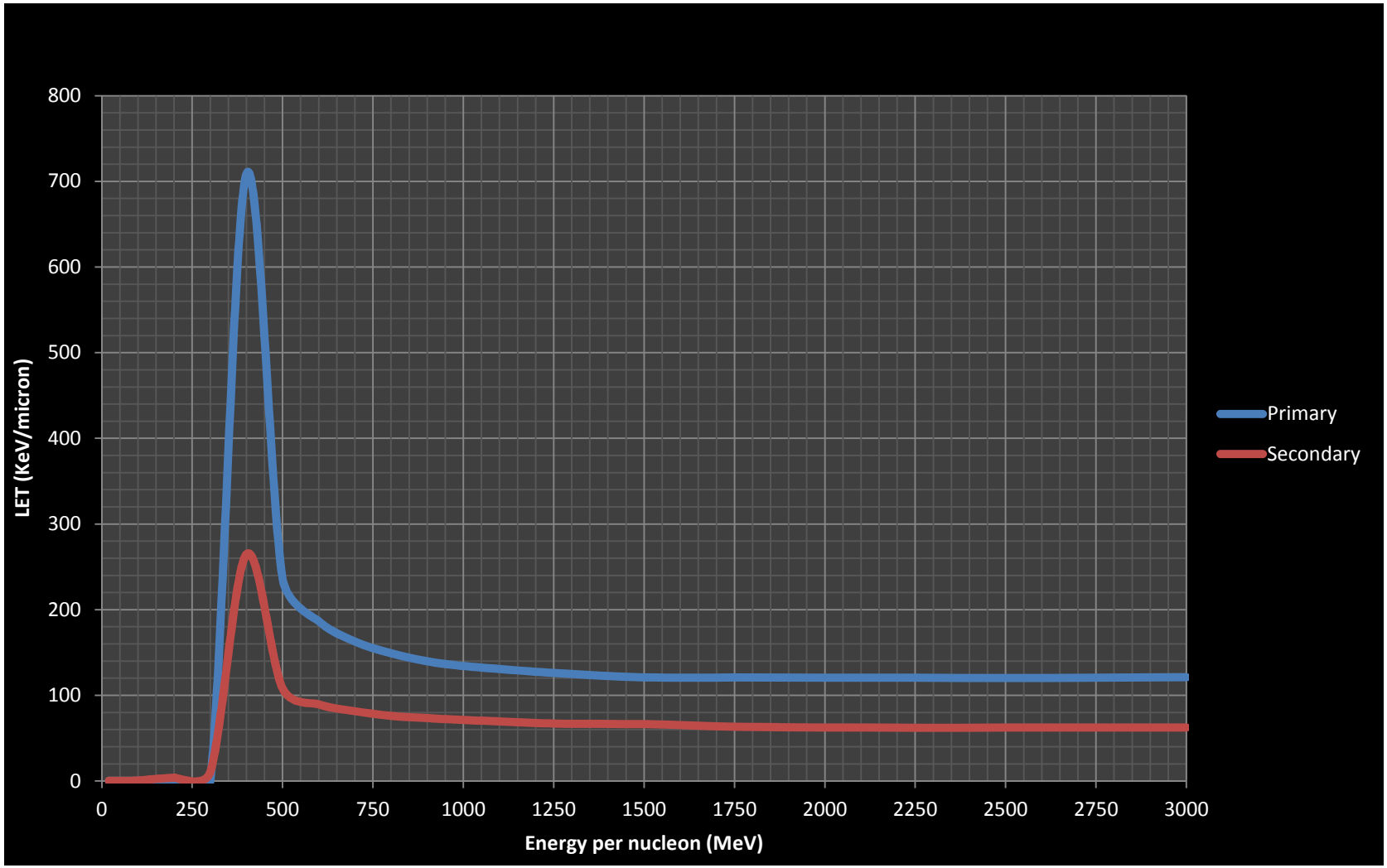


Figure 24. Iron LET vs. Incoming Ion Energy for Detector 4

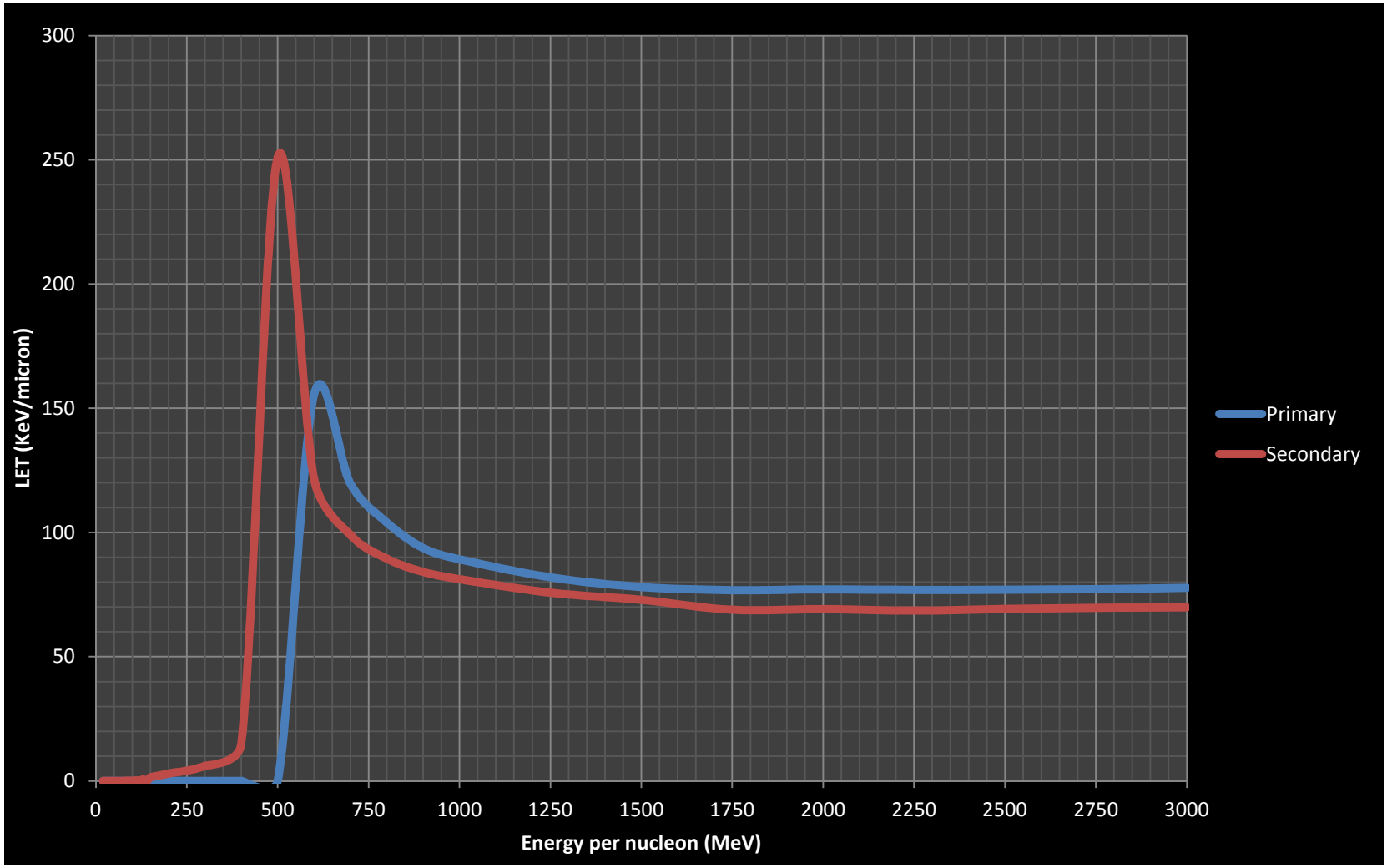


Figure 25. Iron LET vs. Incoming Ion Energy for Detector 5

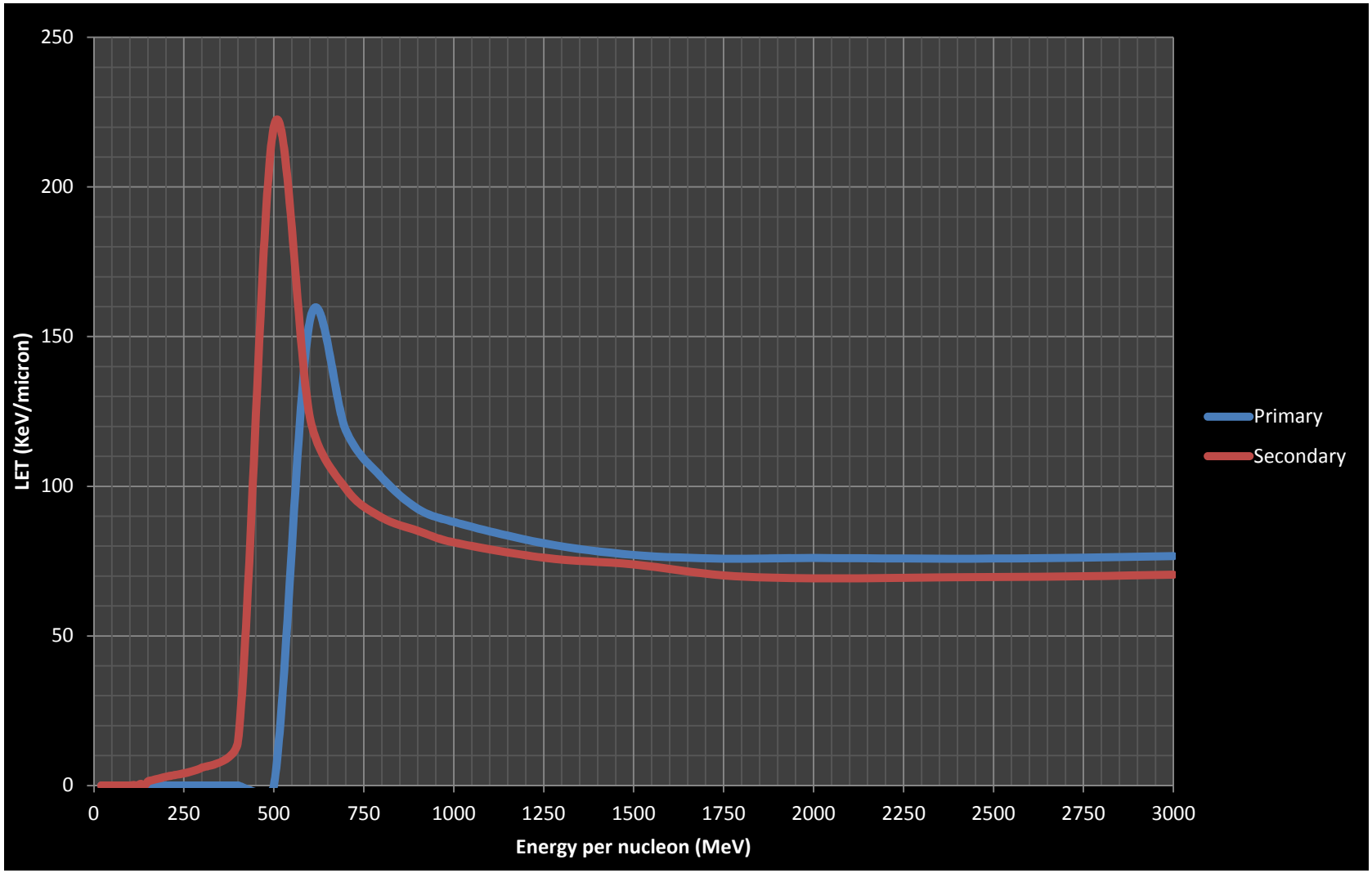


Figure 26. Iron LET vs. Incoming Ion Energy for Detector 6

The tables containing the average LET versus energy per nucleon for each incident ion can be found in the Appendix. These figures show that unlike heavy ions, light ions do not have significant secondary particle contributions to the overall LET. Heavy ion secondary contribution is high throughout the penetration of the detector stack. Detector 6 has considerably more energy deposited by secondary particles in comparison to the other detectors (1-5).

The next step is to use suitable curve fit software, Table Curve 2D Version 5.01, to obtain an energy dependent LET fit equation. The following, Figure 27, is an example of the curve fit software. It is the curve fit analysis for primary protons in detector 1.

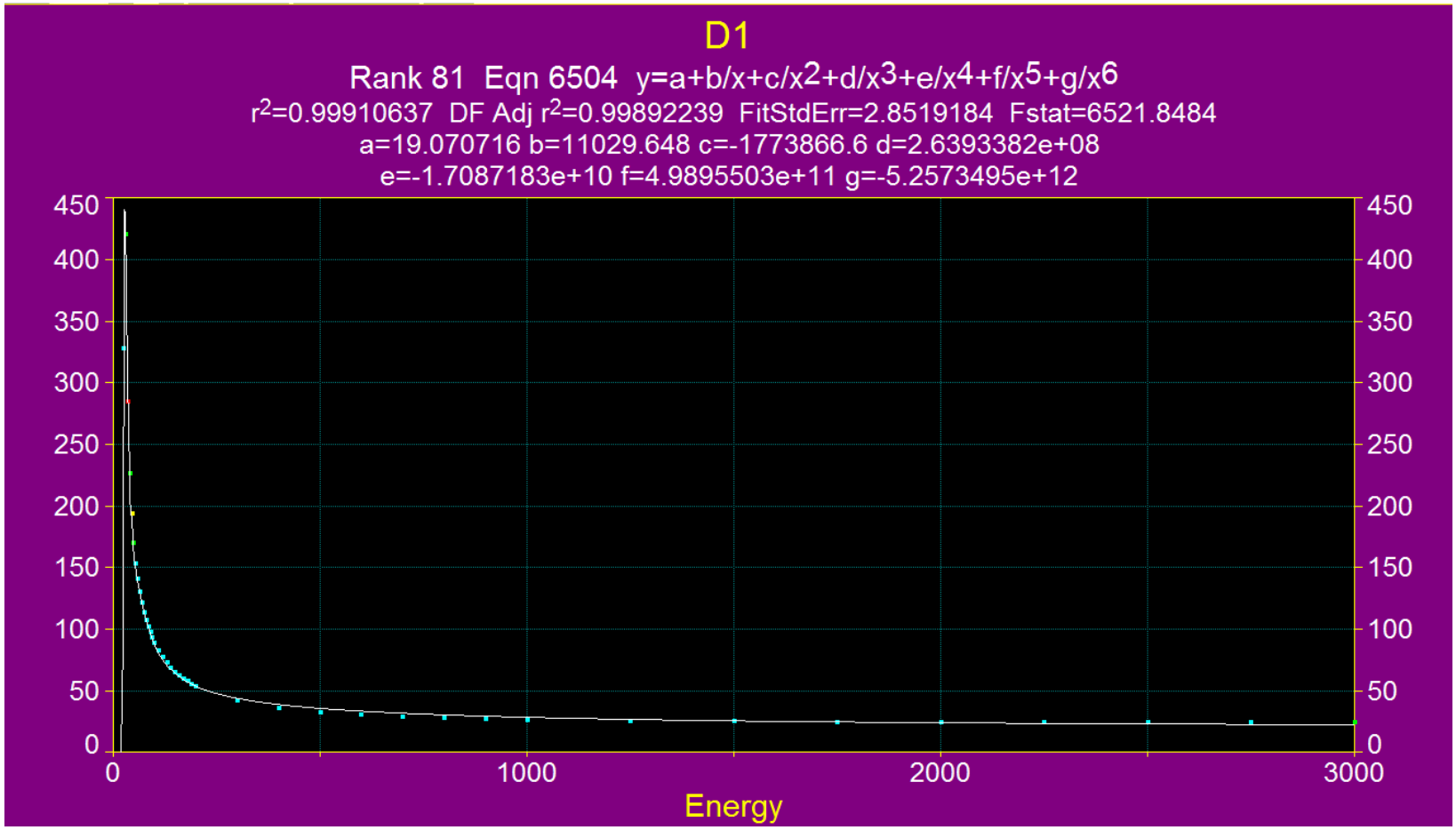


Figure 27. Curve Fit Program Analysis for Primary Protons in Detector

This analysis is carried out for each ion in each component of CRaTER. In past work, primary and secondary energy depositions were lumped together. In this research there was a separate curve fit analysis done for each, and their corresponding LET lookup tables can be found in the Appendix.
Using the Badhwar-O'Neill GCR spectra averaged over the year 2010, the predicted energy values are folded into the look-up tables to give their corresponding LETs.

5.3. HZETRN

Using HZETRN, CRaTER dimensions are not modeled exactly as in HETC-HEDS. In HZETRN, CRaTER is treated as slabs of different materials. The true thicknesses and materials of CRaTER are modeled while the radius is not. This is because HZETRN is a one dimensional code that does not treat angular effects. The GCR environment for the year 2010 was not originally included in the available environments in the codes. Using Badhwar O'Neill, the GCR energy spectra needed were added to the usable environments to conduct the simulation. HZETRN automatically calculates the LET spectra so no further data analyses are needed.

6. RESULT COMPARISONS

These results comparisons show observed CRaTER data averaged for each day over the entire year 2010. The observed CRaTER data are combined results for detector 1 and detector 2 for their respective cutoff energy ranges. Detector 2 results are used up to an LET of 90 keV/micron, whereas detector 1 results are used for LET ≥ 90 keV/micron. The observed CRaTER data are binned by:

- 0 – 10 keV/micron binned by 100 particles per bin
- 10 – 30 keV/micron binned by 50 particles per bin
- 30 – 90 keV/micron binned by 25 particles per bin
- 90 + keV/micron binned by 5 particles per bin

Figure 28 shows the observed data with the D2/D1 detector combination.

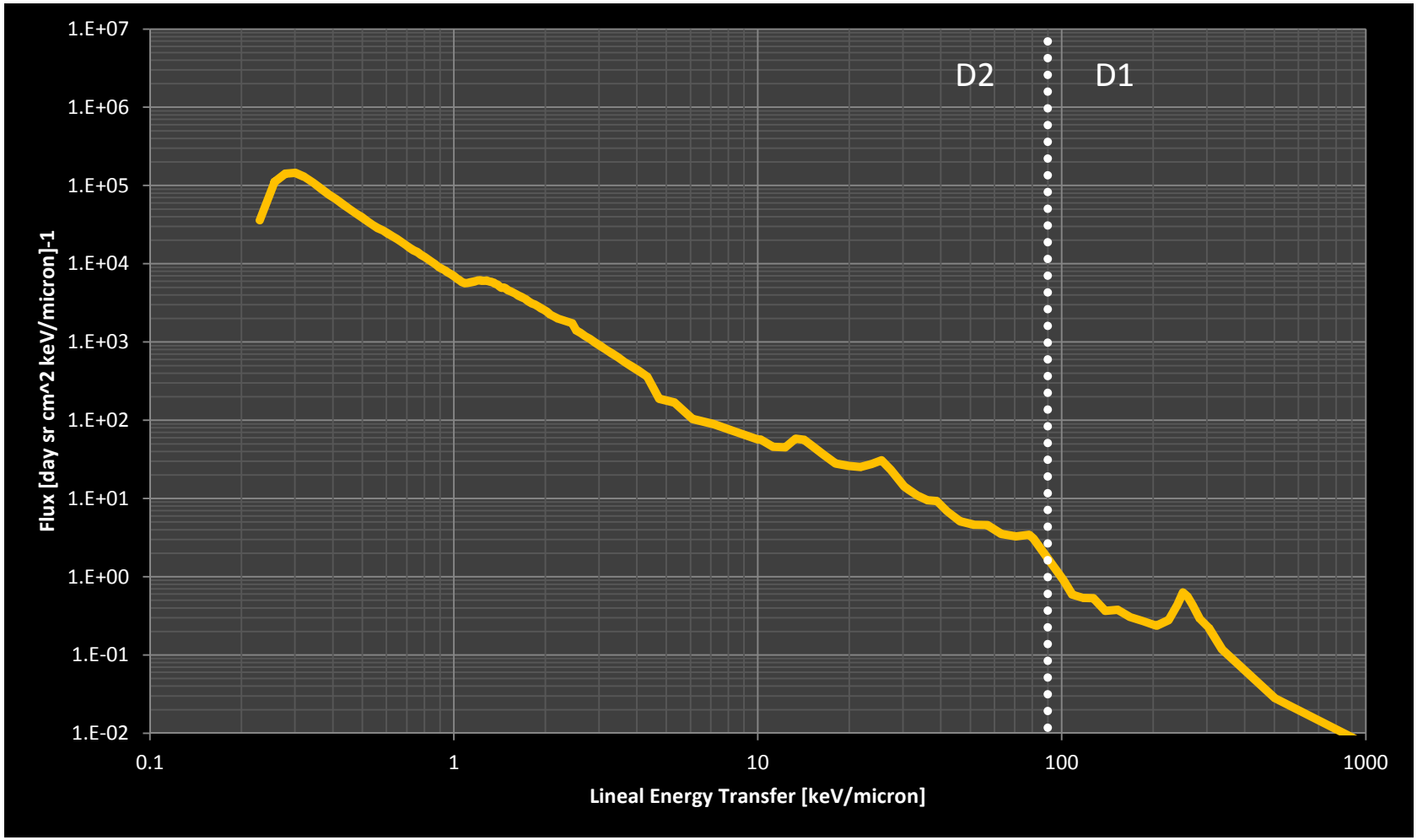


Figure 28. Observed CRaTER Data for 2010

6.1. HETC-HEDS

In past research, primary and secondary particles energy depositions have been lumped together when determining LET. This caused a shift from known expected values of minimum ionizing ion peaks. The following figure, Figure 29, shows HETC-HEDS data with averaged total LET per incident particle for primary particles and secondary particles calculated separately and plotted together against their corresponding fluxes. All the displayed HETC-HEDS results are binned using the same sequence:

- 0 – 3 keV/micron binned by 150 particles per bin
- 3 – 10 keV/micron binned by 25 particles per bin
- 10 – 30 keV/micron binned by 5 particles per bin
- 30 – 100 keV/micron binned by 4 particles per bin
- 100+ keV/micron binned by 0.75 particles per bin

There are two plotting techniques used. The first is a detector cutoff point: (1 Detector 2 results used for LET < 30 keV/micron; (2) Detector 1 results used for LET ≥ 30 keV/micron. For the discussion of this simulation the first process is referred to as “detector cutoff.” The second, more effective technique is done by looking at each individual ions’ contribution for each detector and using the detector results with the best peak fit for each detector. We will refer to this as “individual ion.”

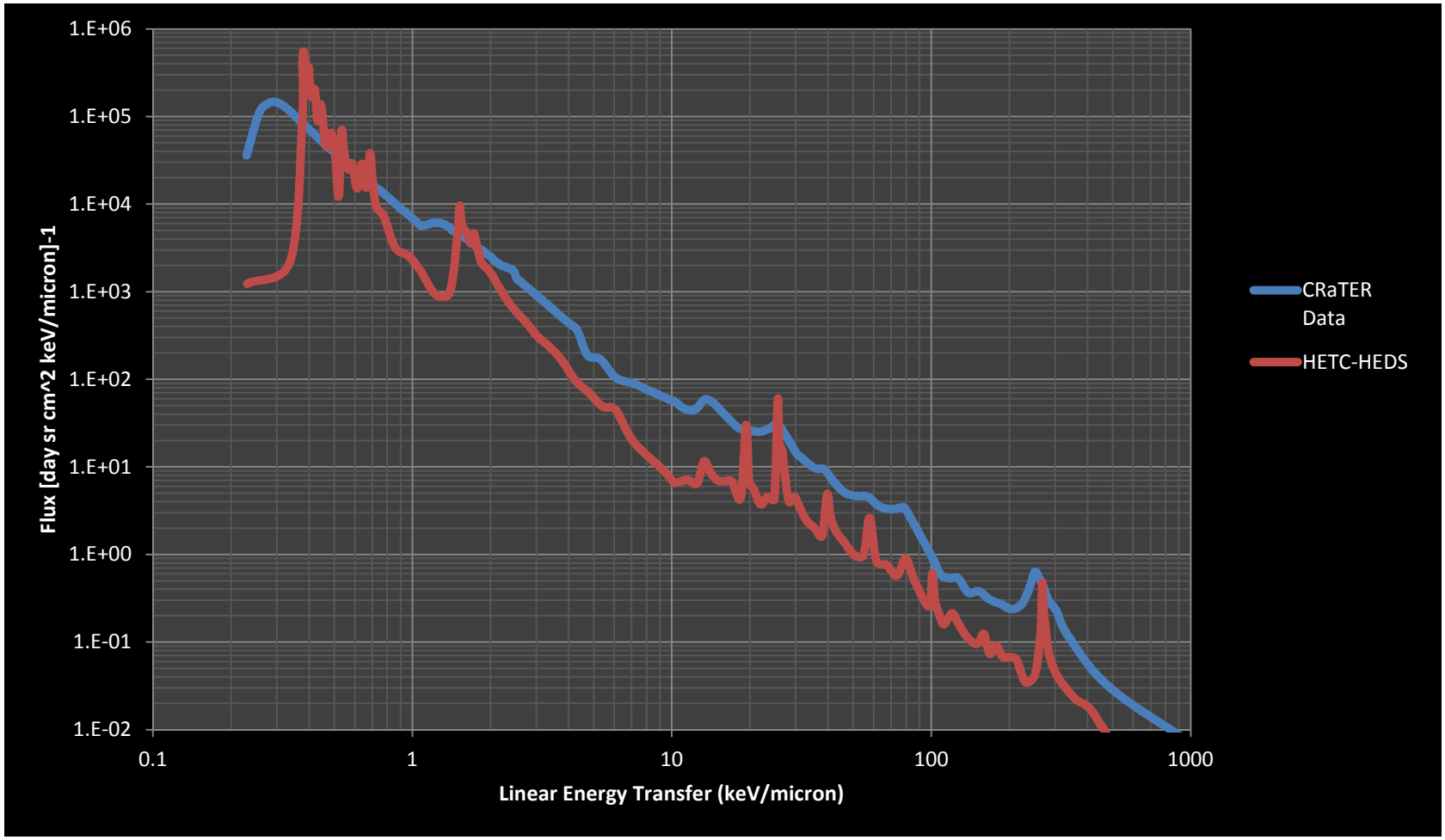


Figure 29. Detector Cutoff Comparison of Observed CRaTER Data and HETC-HEDS with Primary and Secondary Particles Separated

At higher LETs (≥ 10 keV/micron), there seems to be reasonable agreement between minimum ionizing peak locations. The lower LET peaks are shifted and at a higher than expected magnitude. These two peaks correspond to protons and alphas. The observed proton data peak is at ~ 0.30 keV/micron while the HETC-HEDS proton peak is at ~ 0.38 keV/micron. The minimizing ionizing value for protons from Bethe-Bloch theory is ~0.37 keV/micron. The observed CRaTER value is somewhat less than the expected theoretical value. This is probably caused by energetic delta rays escaping from the detectors before depositing all of their energies. Figures 30 – 39 show the complexity in secondary distribution. In these figures "type of particle" is actually the TIP of the particle contributing the energy. TIP is defined at the atomic number of a particle (A) x 1000 + the charge of the particle (Z).

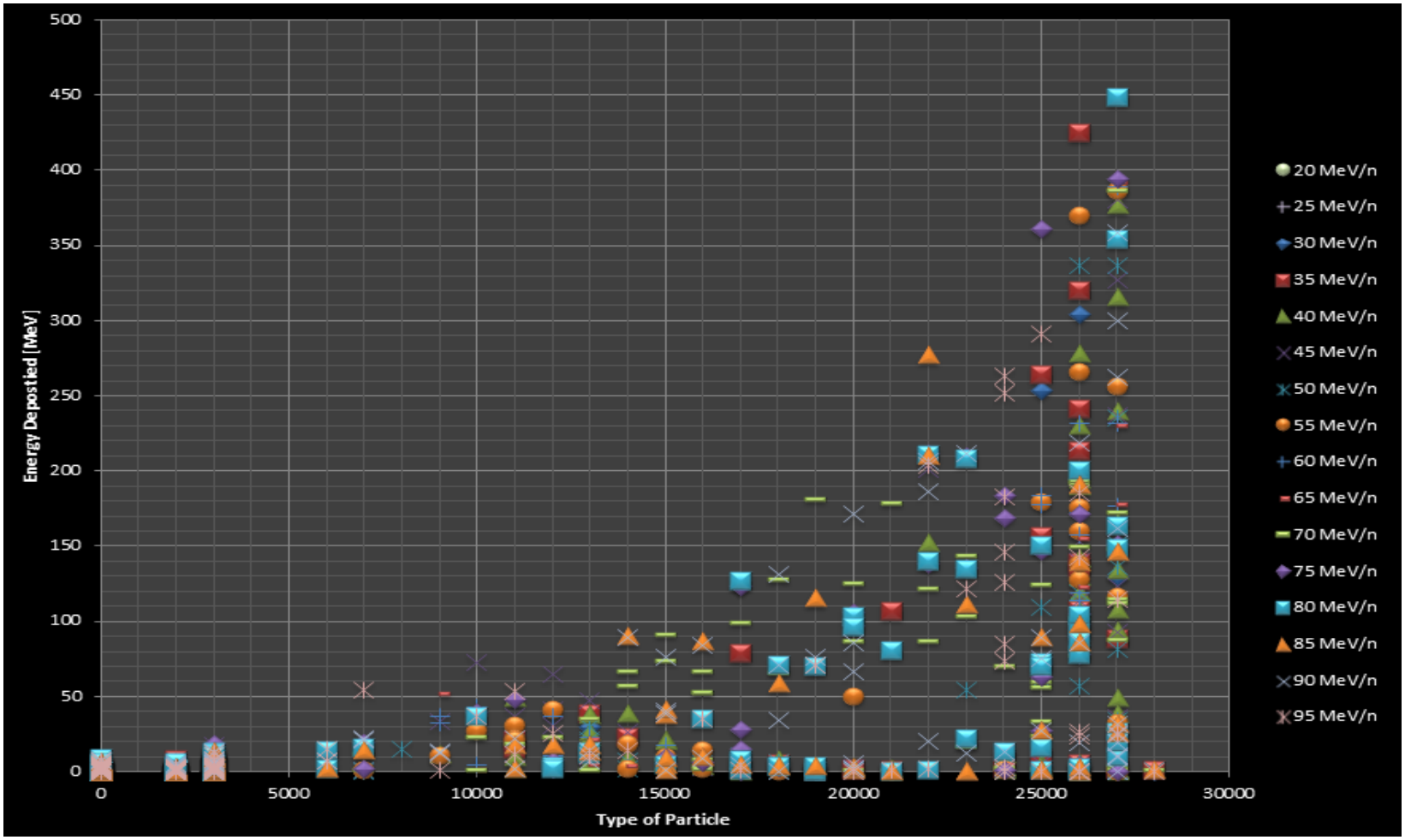


Figure 30. Secondary Distributions from Primary Alphas 20 – 95 MeV/n in Detector 1 (Displayed are Energy Deposition versus TIP value)

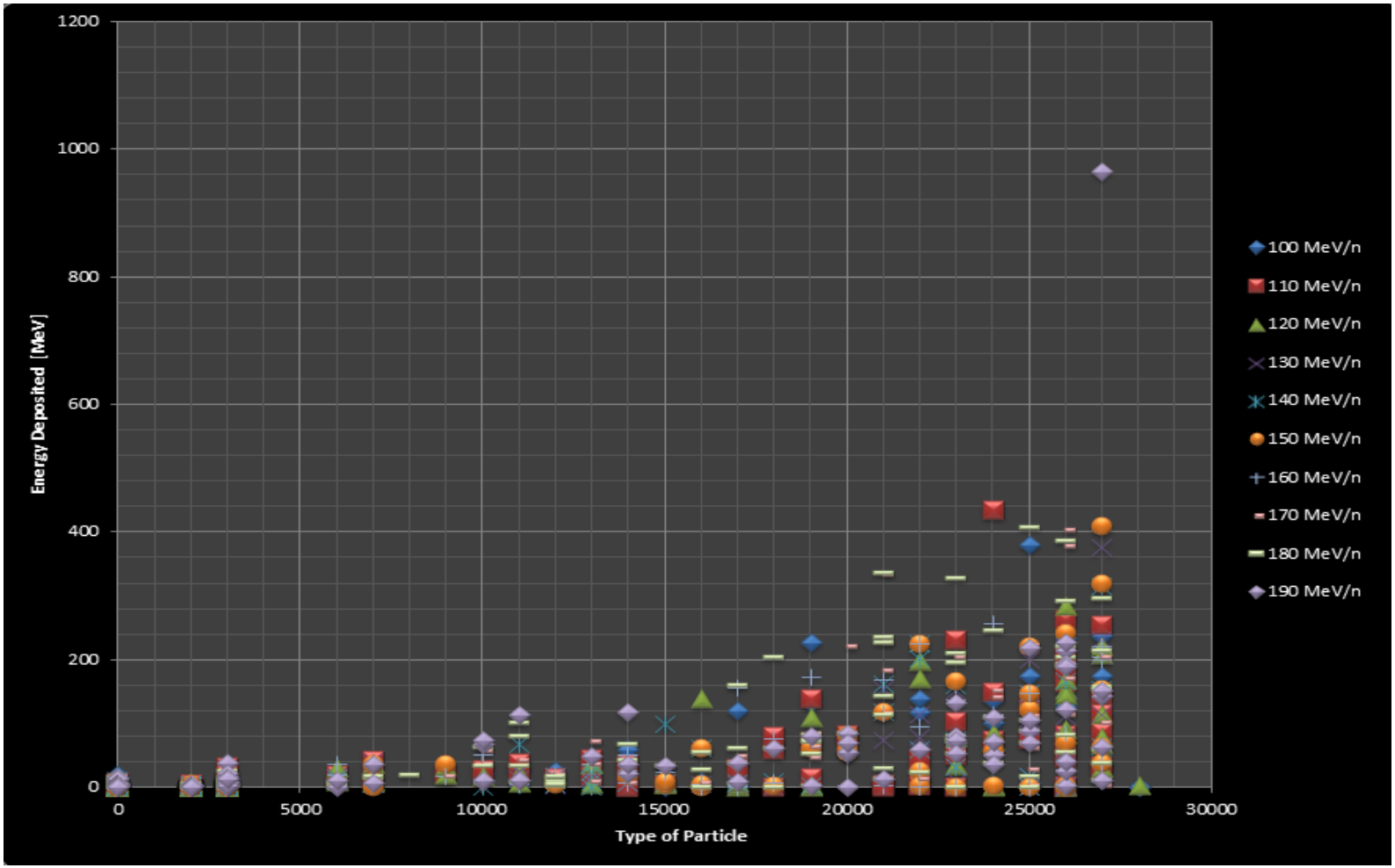


Figure 31. Secondary Distributions from Primary Alphas 100-190 MeV/n in Detector 1 (Displayed are Energy Deposition versus TIP value)

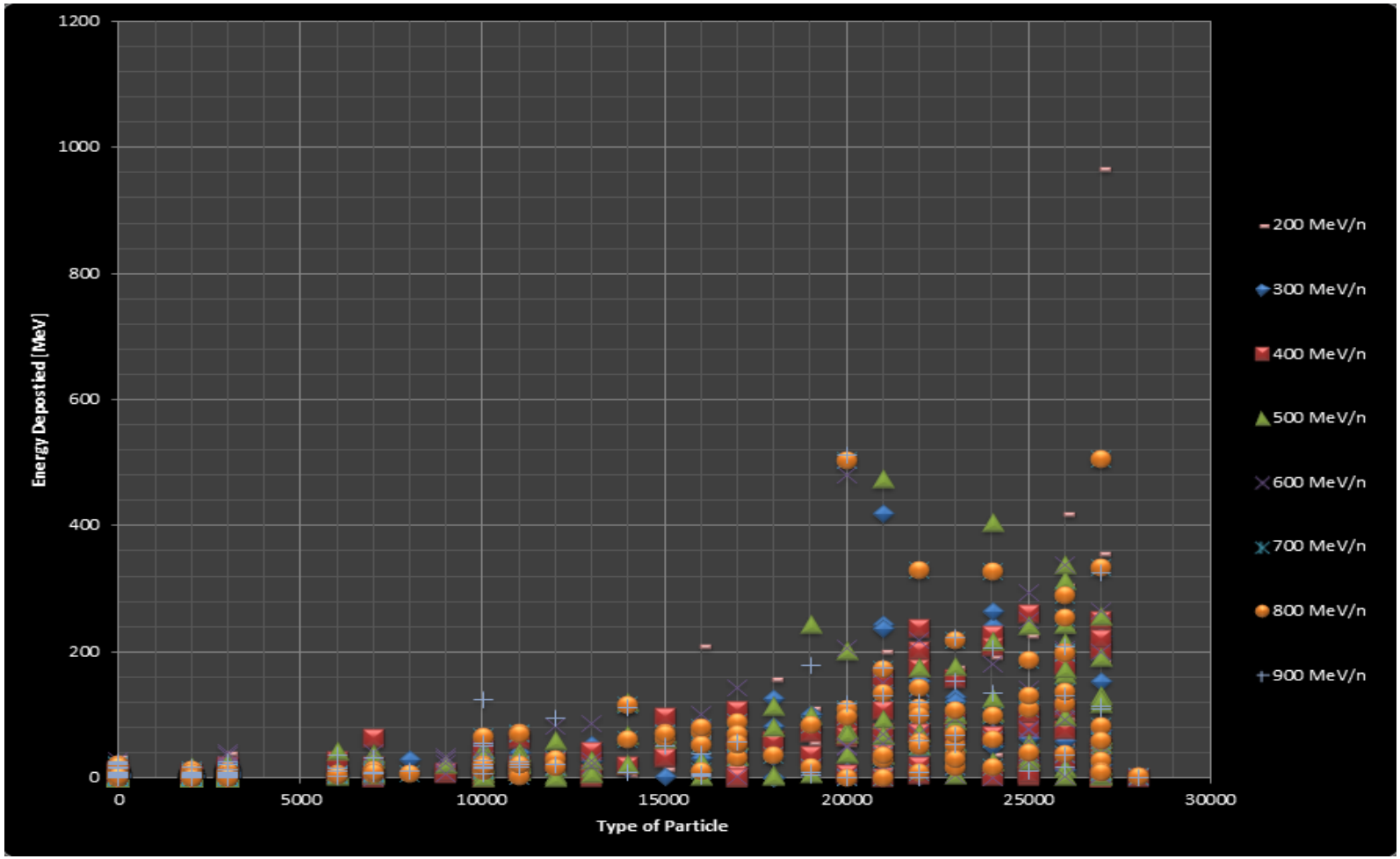


Figure 32. Secondary Distributions from Primary Alphas 200-900 MeV/n in Detector 1 (Displayed are Energy Deposition versus TIP value)

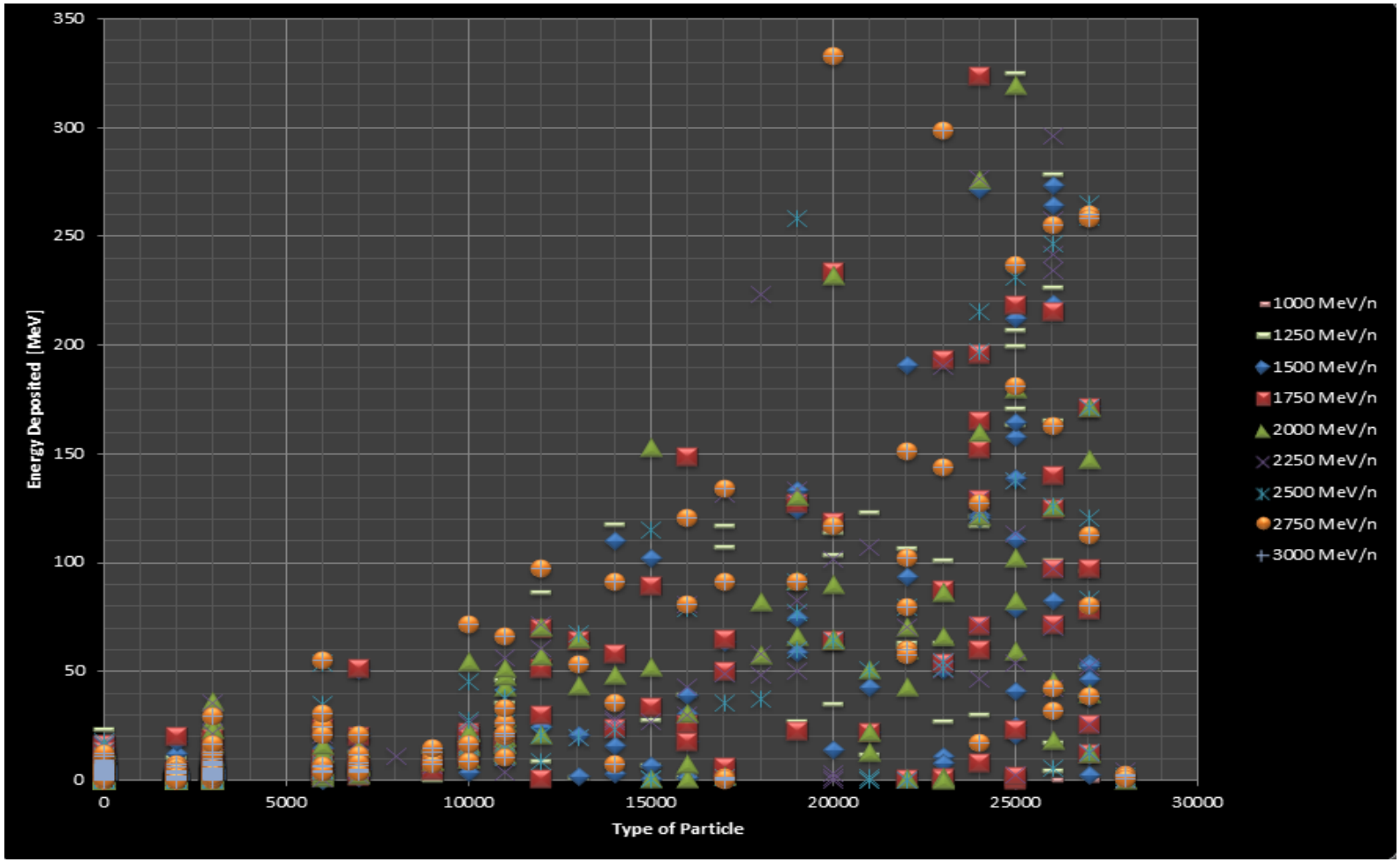


Figure 33. Secondary Distributions from Primary Alphas 1000-3000 MeV/n in Detector 1 (Displayed are Energy Deposition versus TIP value)

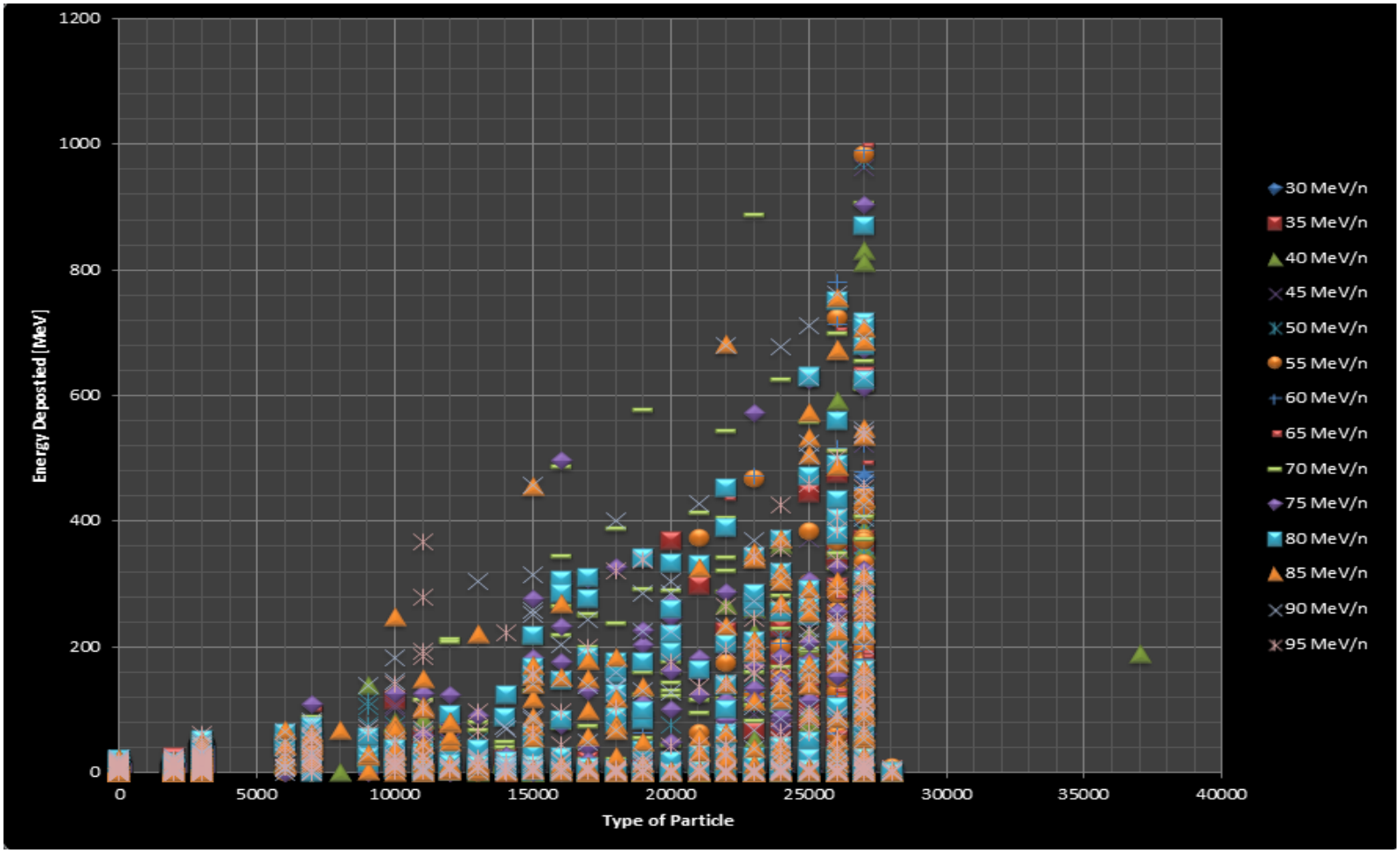


Figure 34. Secondary Distributions from Primary Alphas 20-95 MeV/n in Detector 2 (Displayed are Energy Deposition versus TIP value)

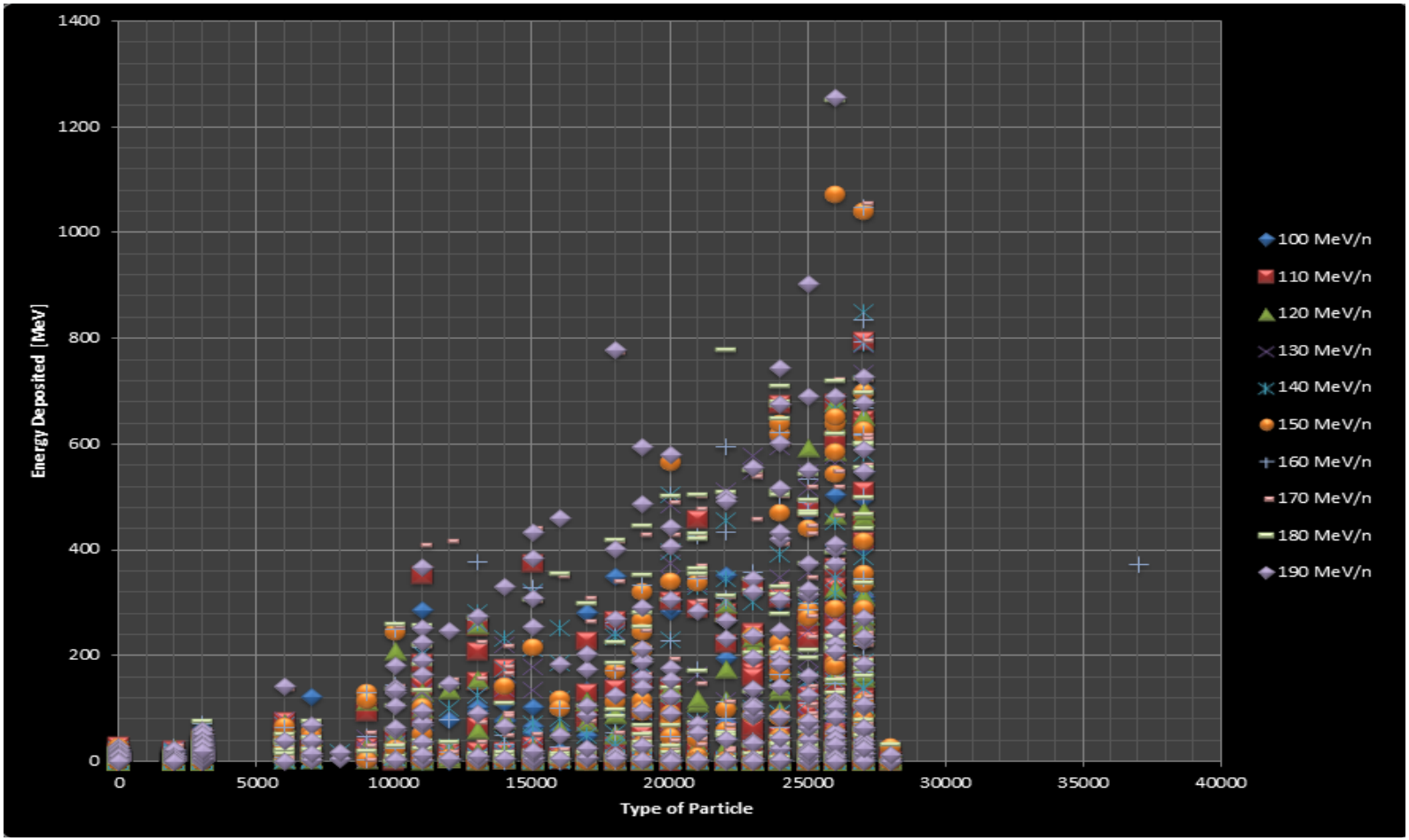


Figure 35. Secondary Distributions from Primary Alphas 100-190 MeV/n in Detector 2 (Displayed are Energy Deposition versus TIP value)

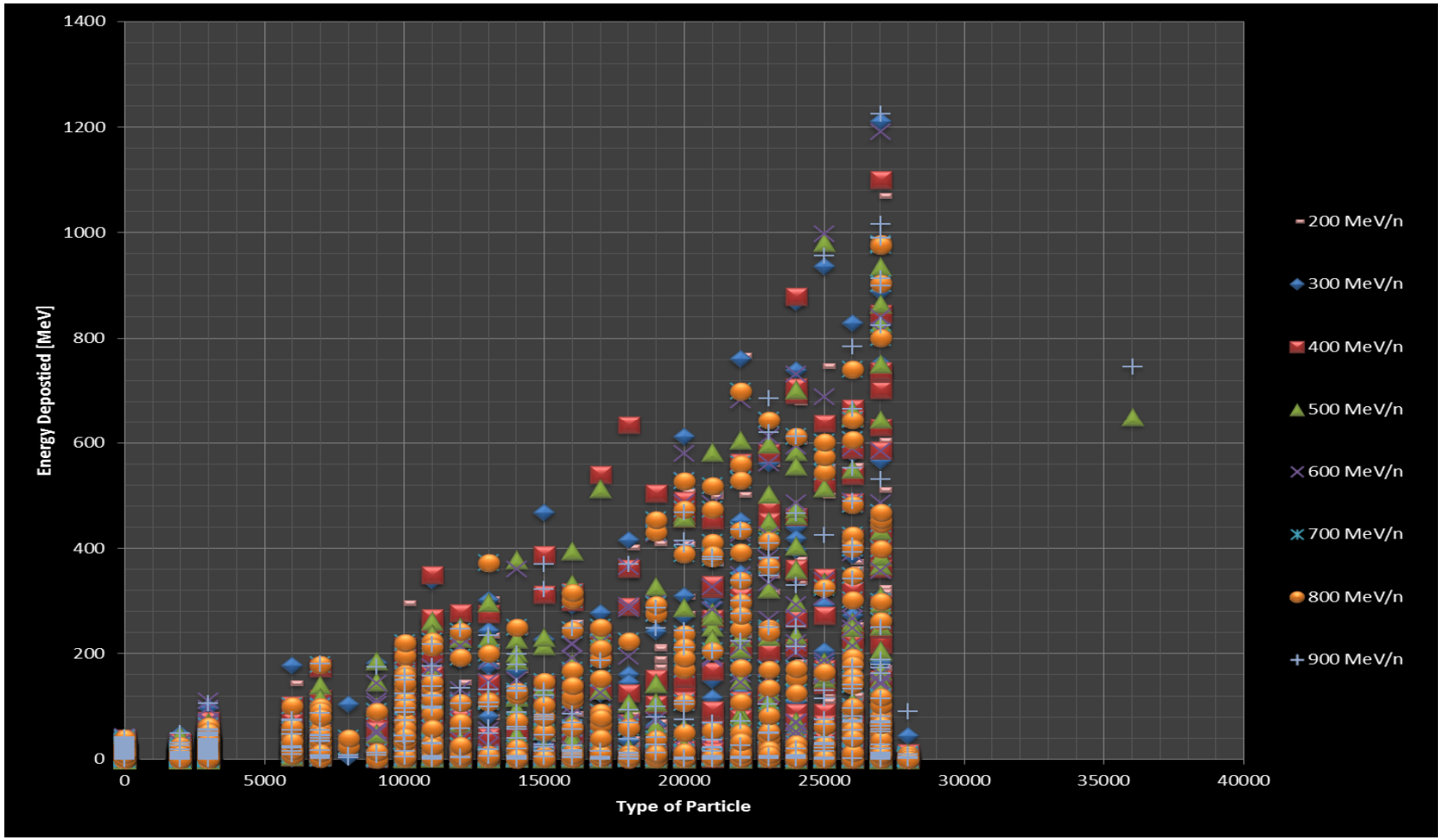


Figure 36. Secondary Distributions from Primary Alphas 200-900 MeV/n in Detector 2 (Displayed are Energy Deposition versus TIP value)

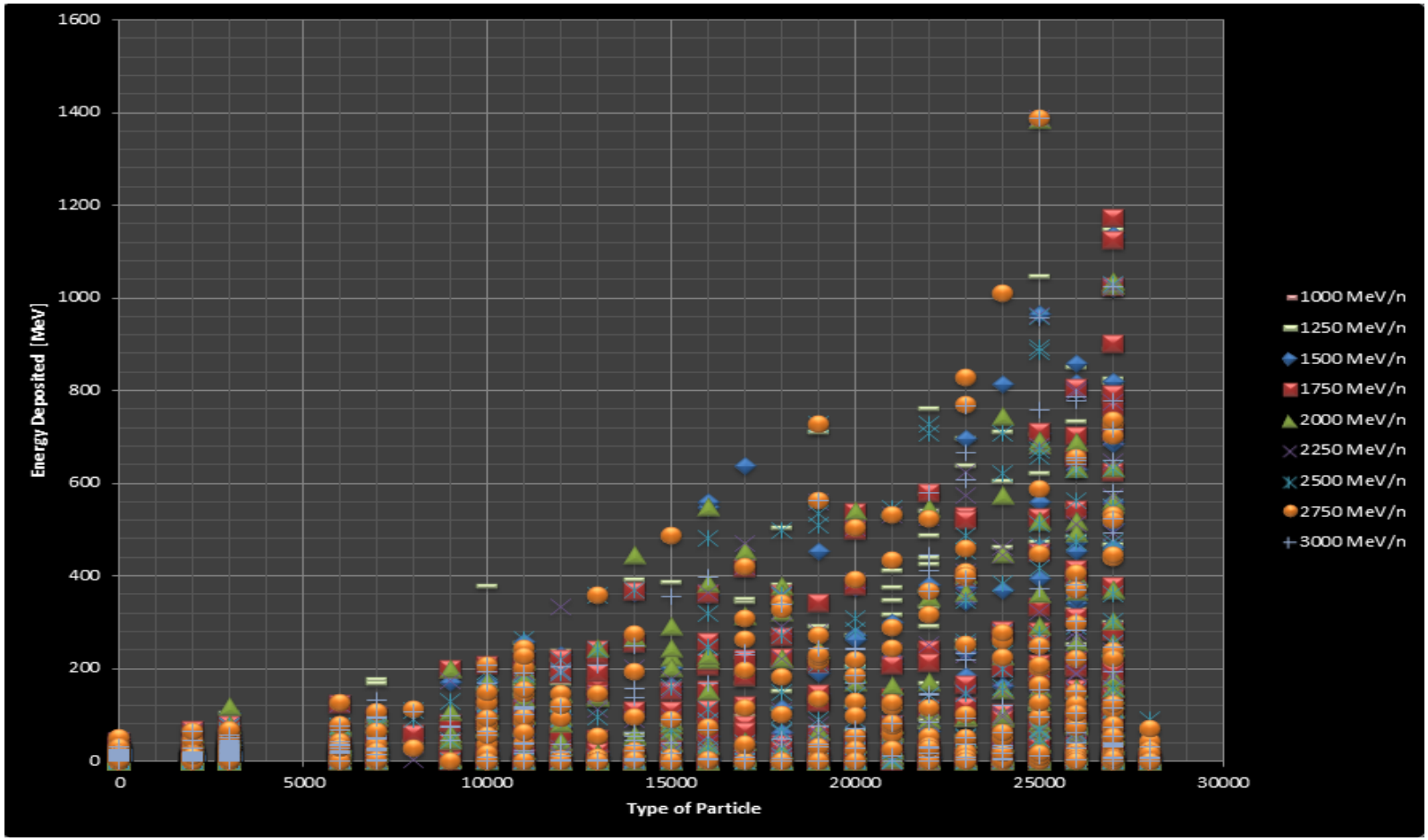


Figure 37. Secondary Distributions from Primary Alphas 1000-3000 MeV/n in Detector 2 (Displayed are Energy Deposition versus TIP value)

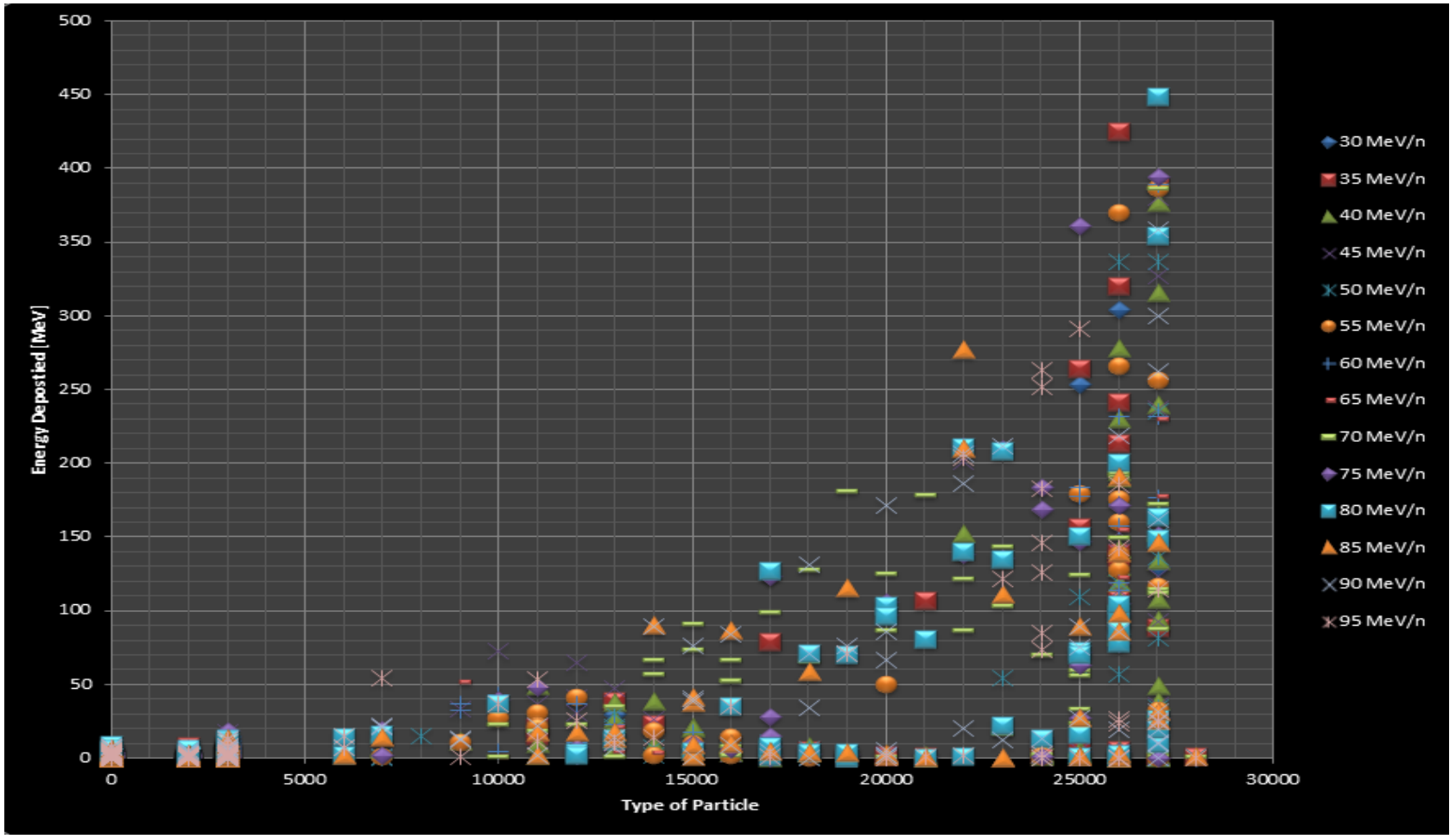


Figure 38. Secondary Distributions from Primary Irons 20-95 MeV/n in Detector 1 (Displayed are Energy Deposition versus TIP value)

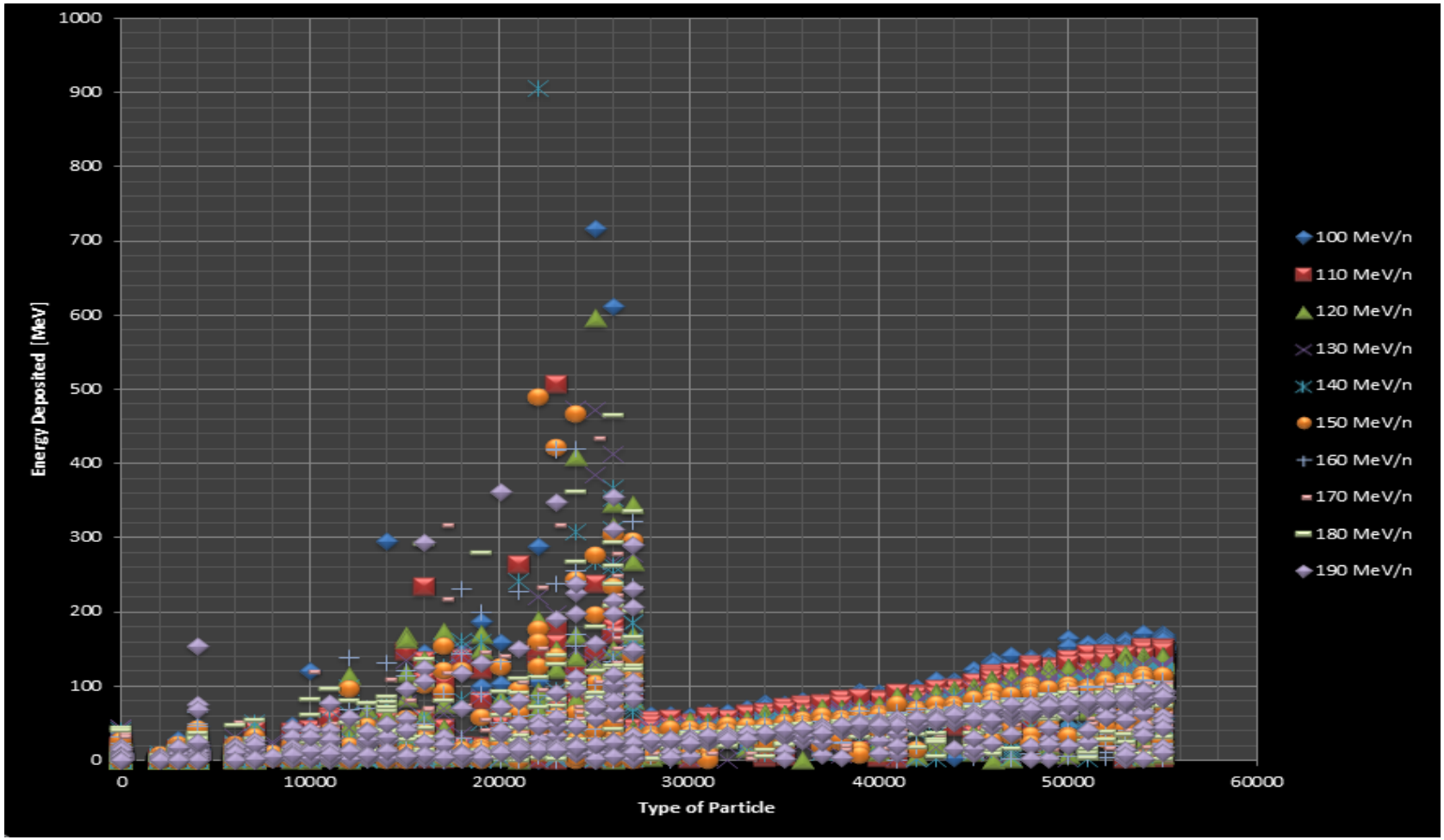


Figure 39. Secondary Distributions from Primary Irons 100-190 MeV/n in Detector 1 (Displayed are Energy Deposition versus TIP value)

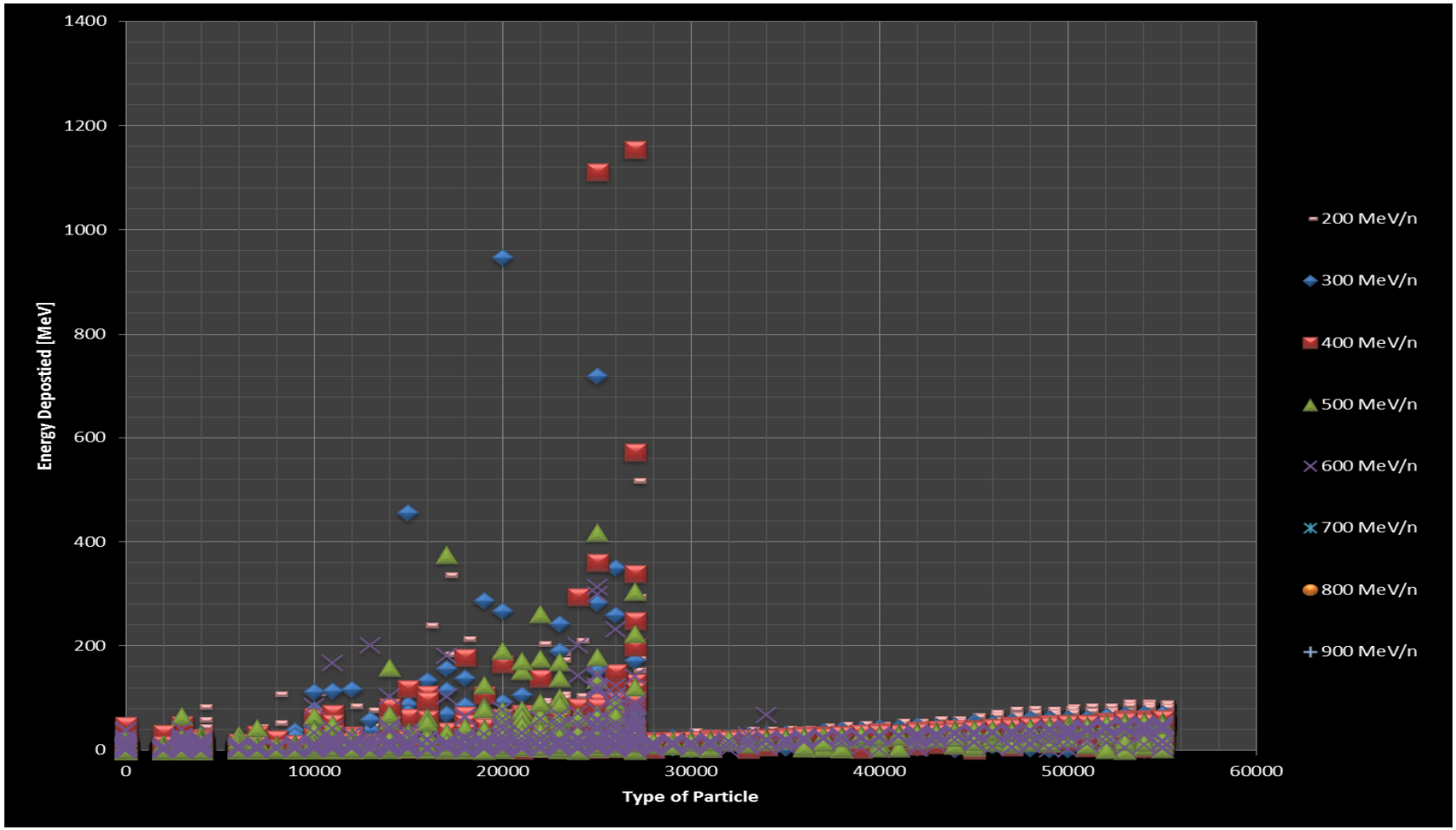


Figure 40. Secondary Distributions from Primary Irons 200-900 MeV/n in Detector 1 (Displayed are Energy Deposition versus TIP value)

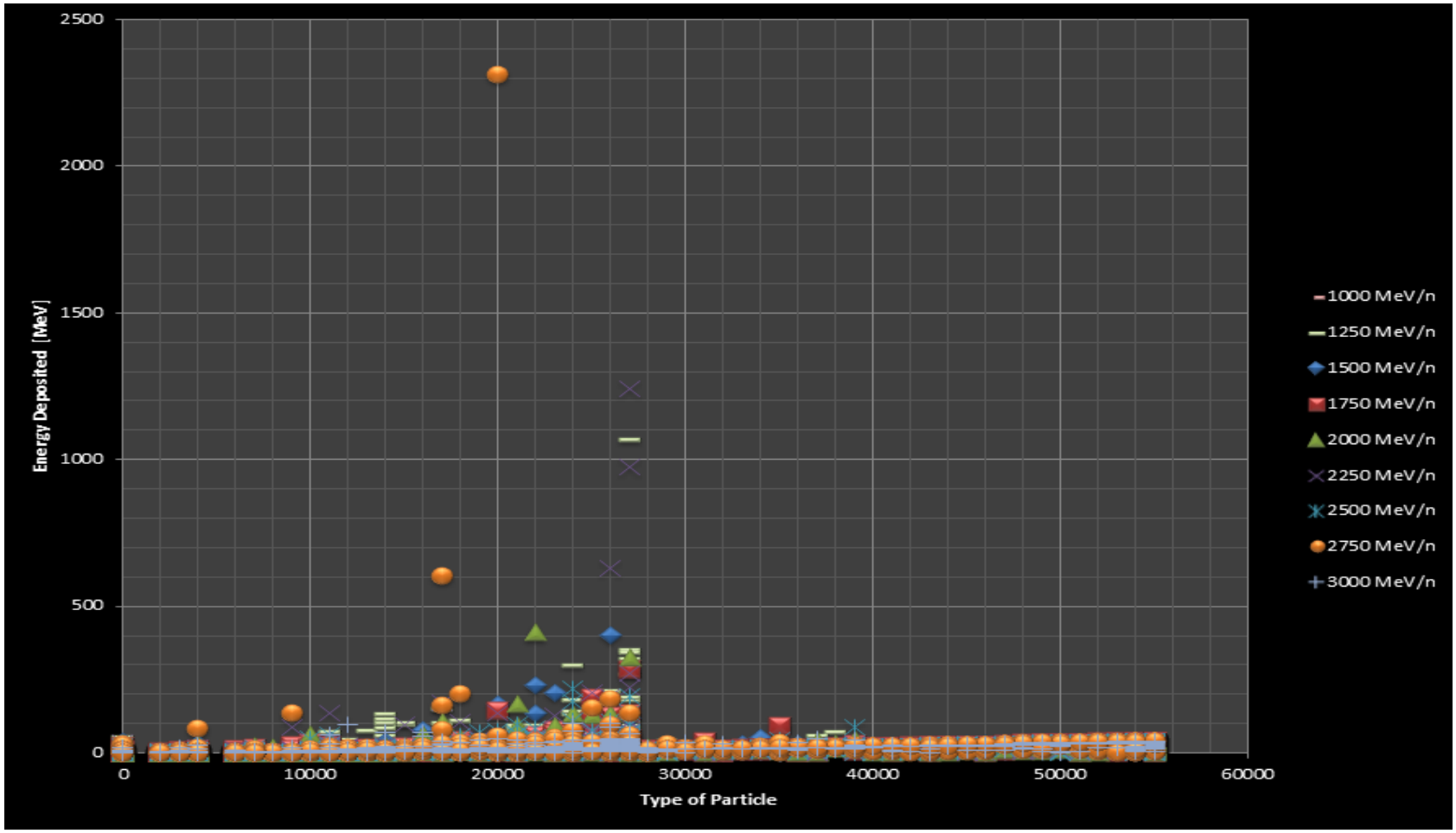


Figure 41. Secondary Distributions from Primary Irons 1000-3000 MeV/n in Detector 1 (Displayed are Energy Deposition versus TIP value)

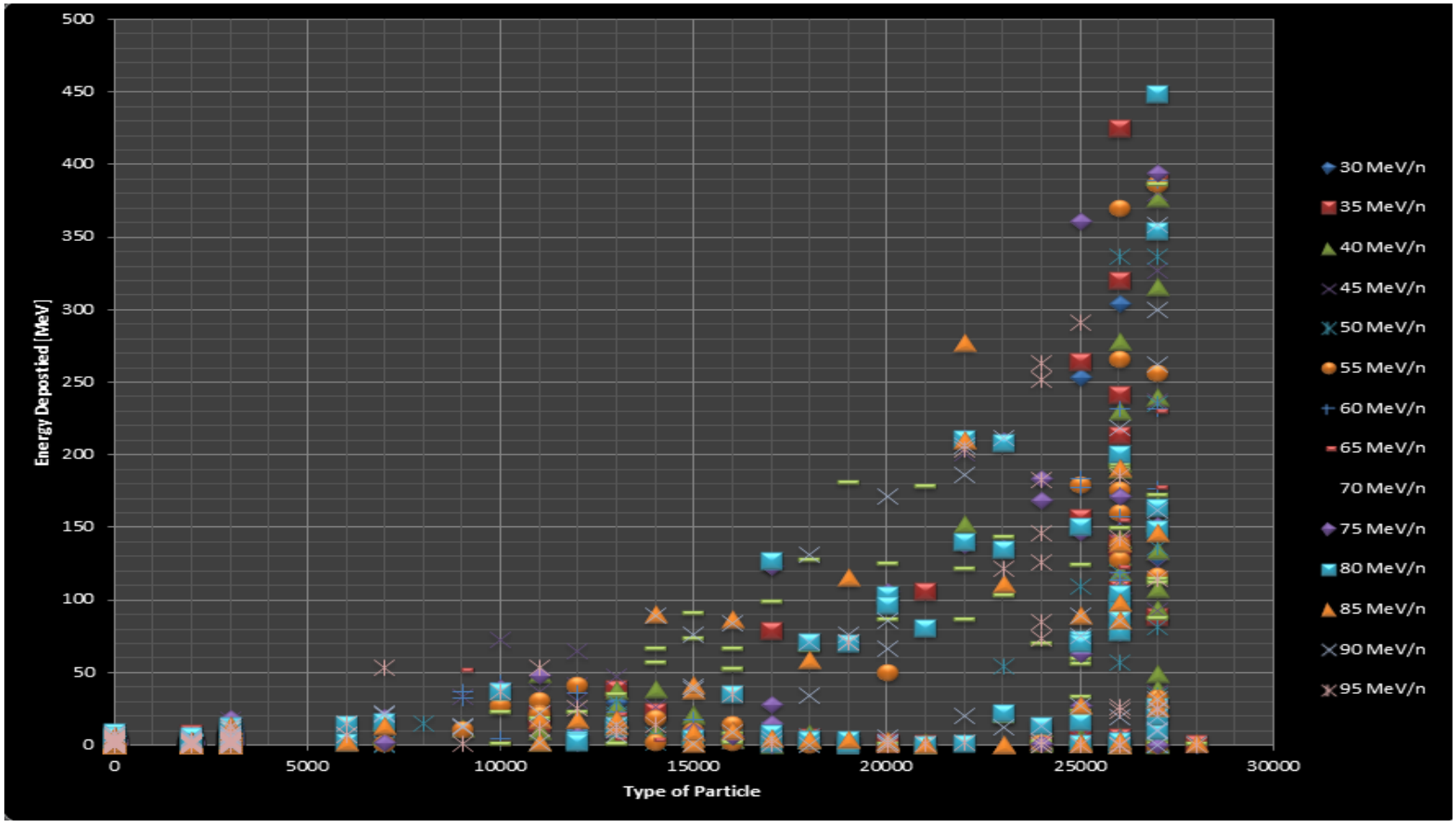


Figure 42. Secondary Distributions from Primary Irons 20-95 MeV/n in Detector 2 (Displayed are Energy Deposition versus TIP value)

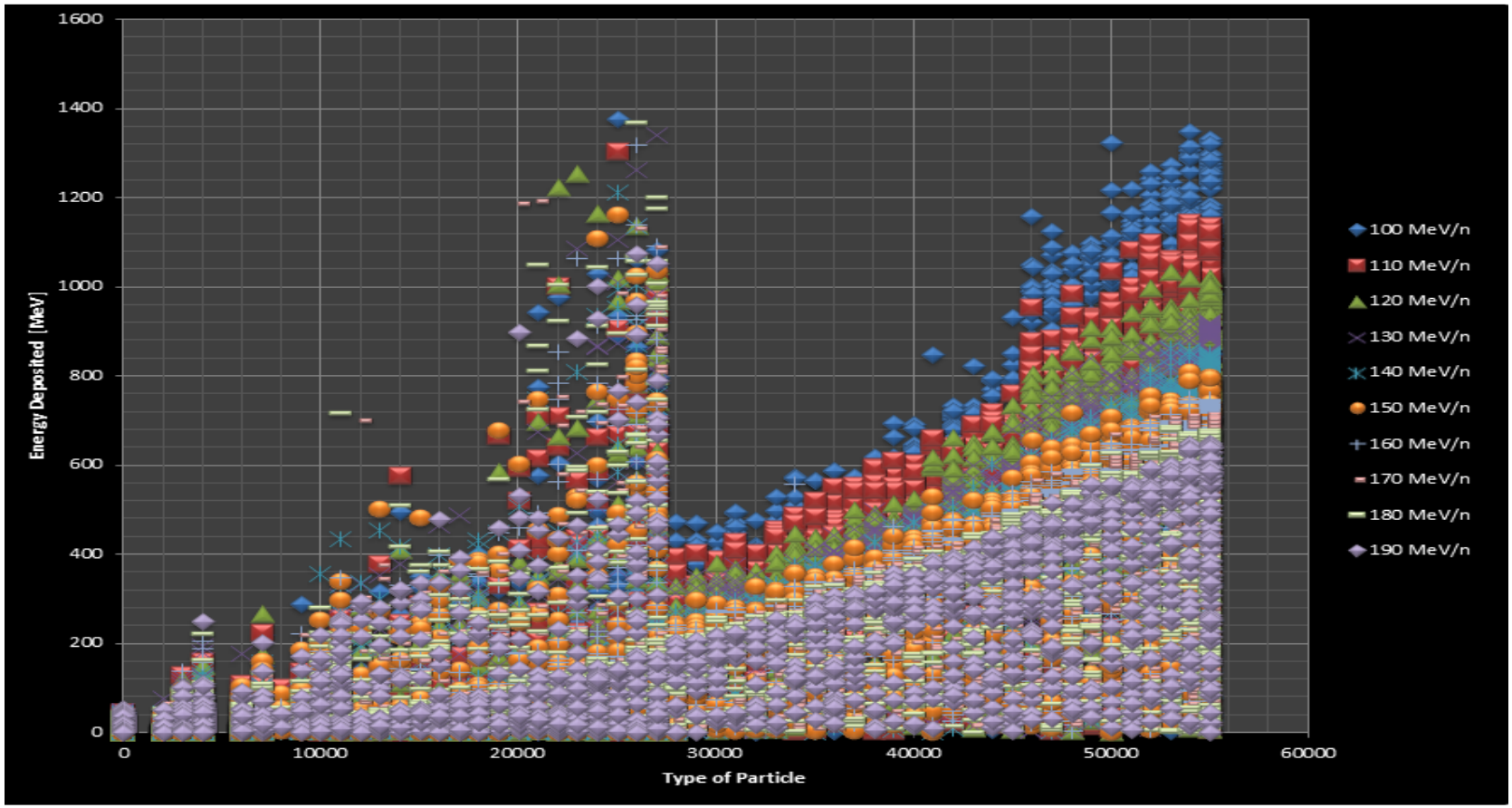


Figure 43. Secondary Distributions from Primary Irons 100-190 MeV/n in Detector 2 (Displayed are Energy Deposition versus TIP value)

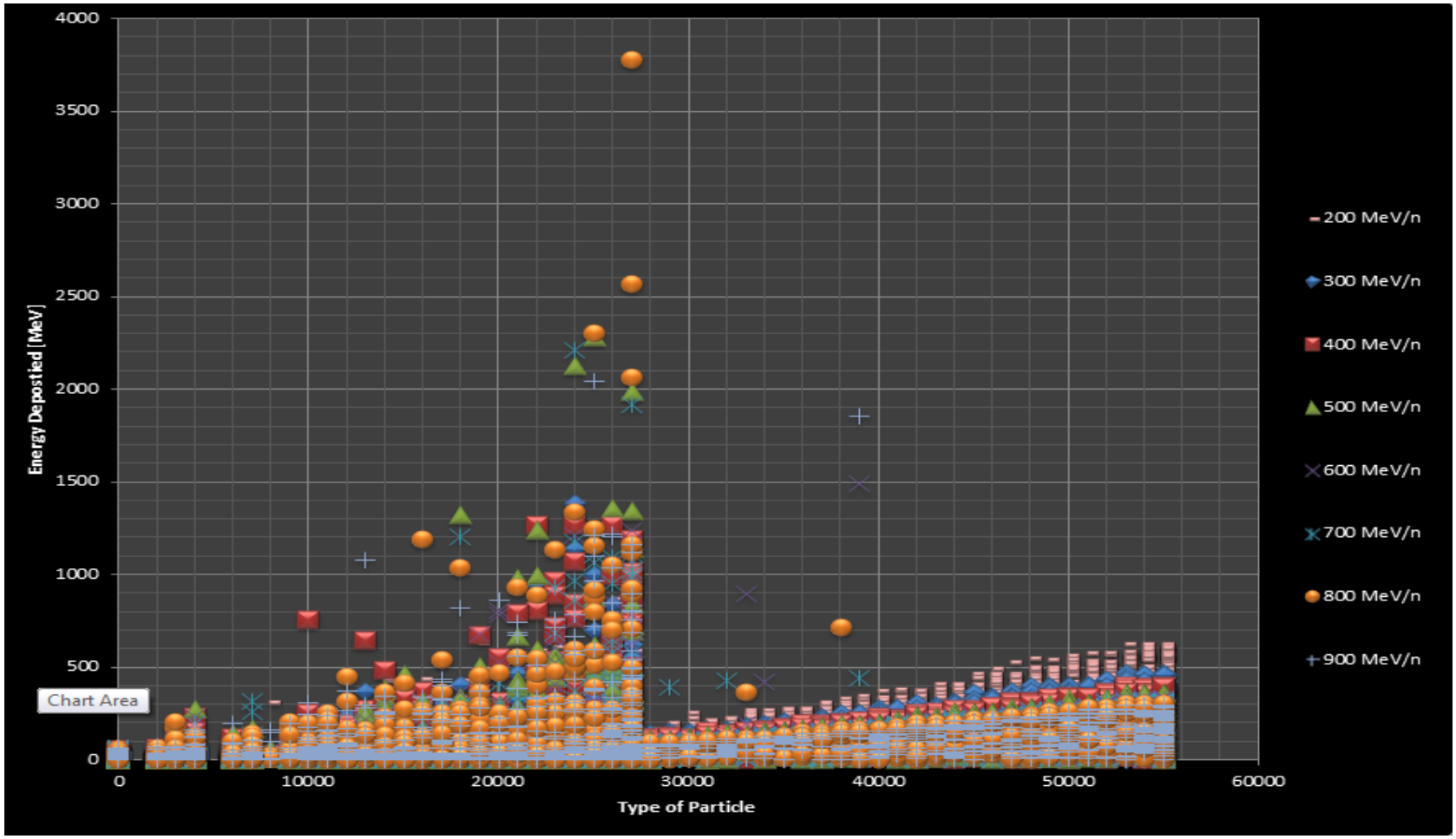


Figure 44. Secondary Distributions from Primary Irons 200-900 MeV/n in Detector 2 (Displayed are Energy Deposition versus TIP value)

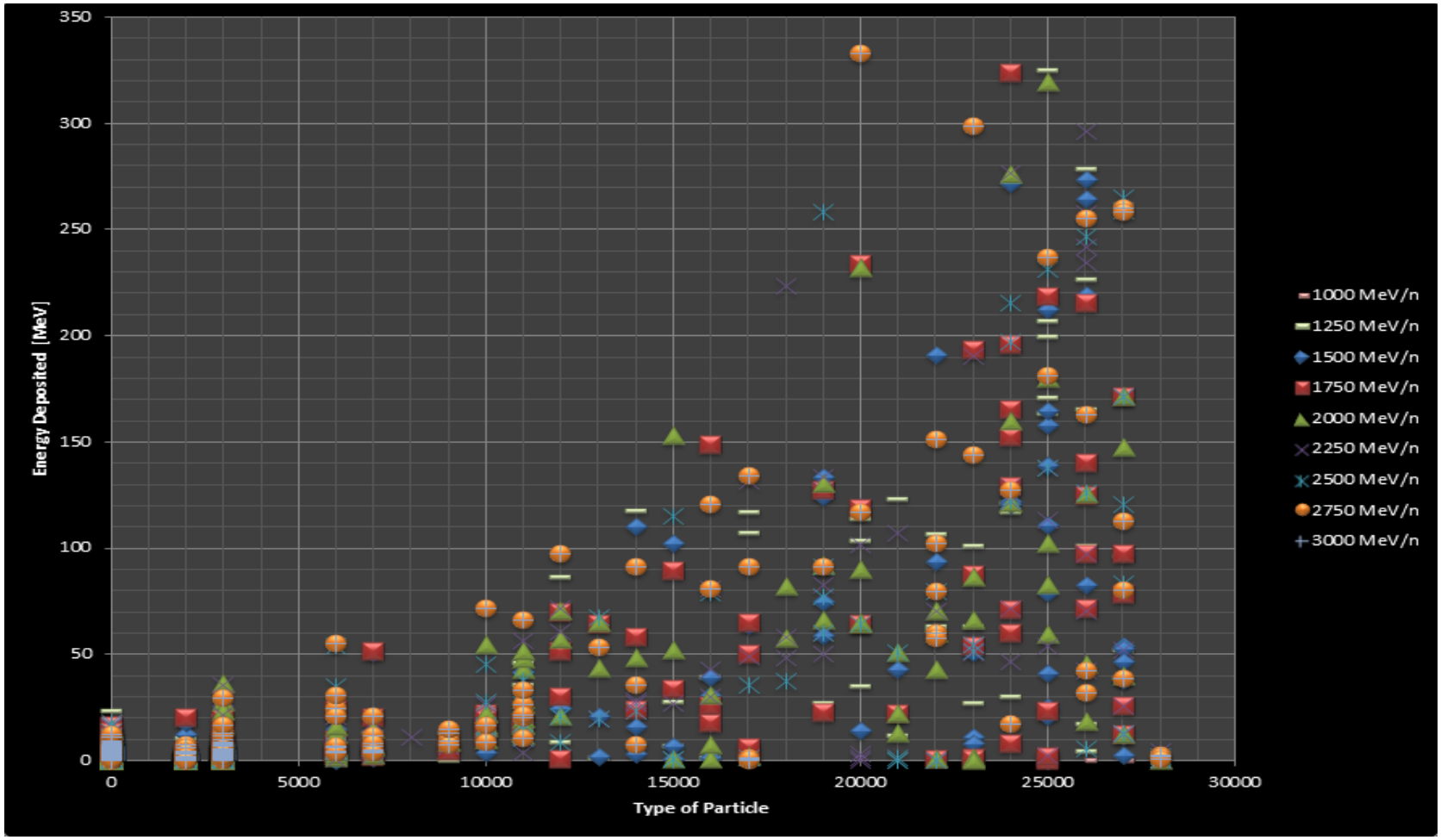


Figure 45. Secondary Distributions from Primary Irons 1000-3000 MeV/n in Detector 2 (Displayed are Energy Deposition versus TIP value)

Clearly these figures demonstrate that secondary particle production produces very complex spectra that are not easily understood. To further understand the secondary contributions to the LET, a plot of each ion (Z = 1 – 26) contribution is needed. The following figures separate individual ion contributions.

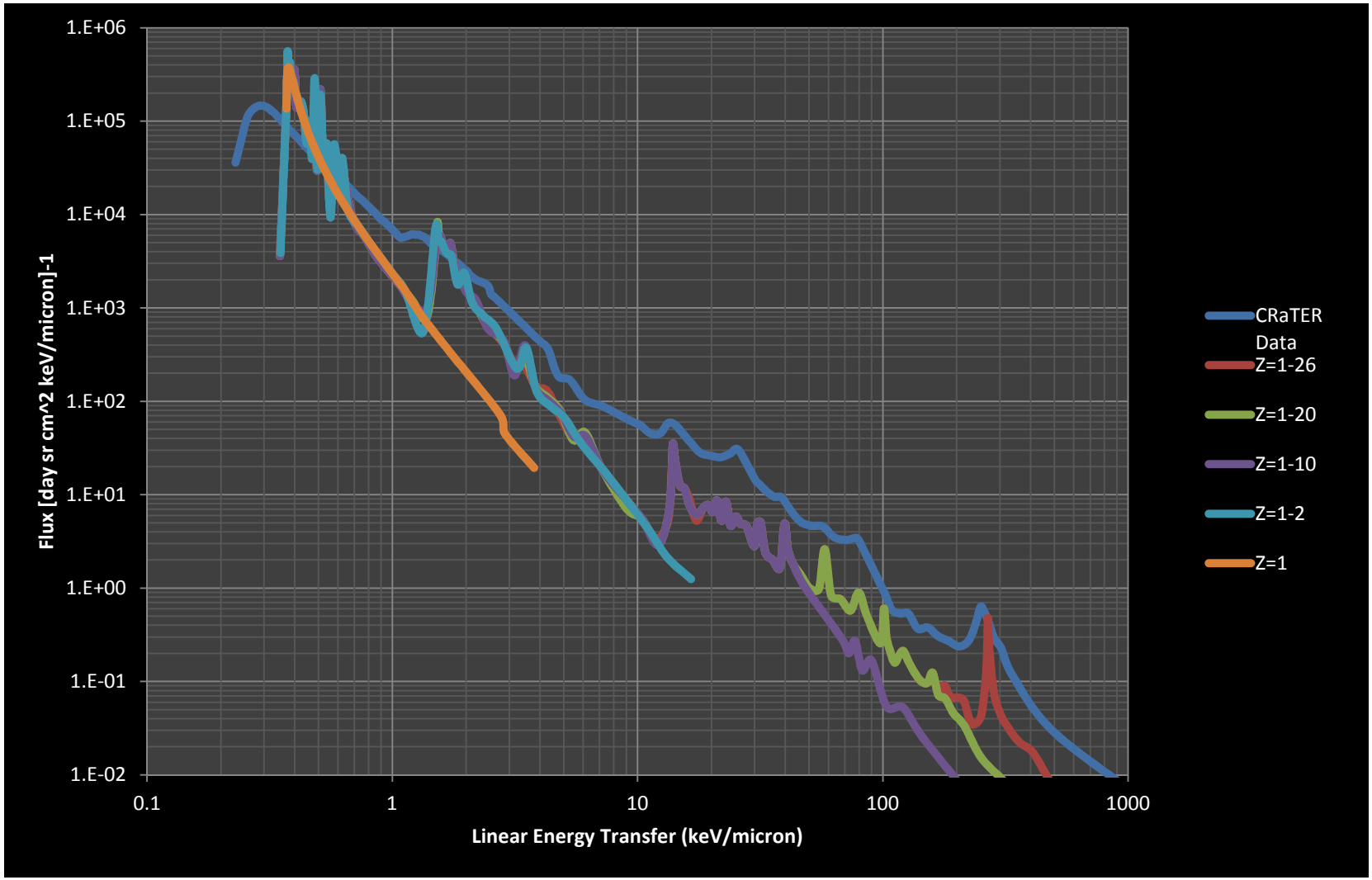


Figure 46. Breakdown of Ion Contribution (Primary and Secondary) for Detector 1

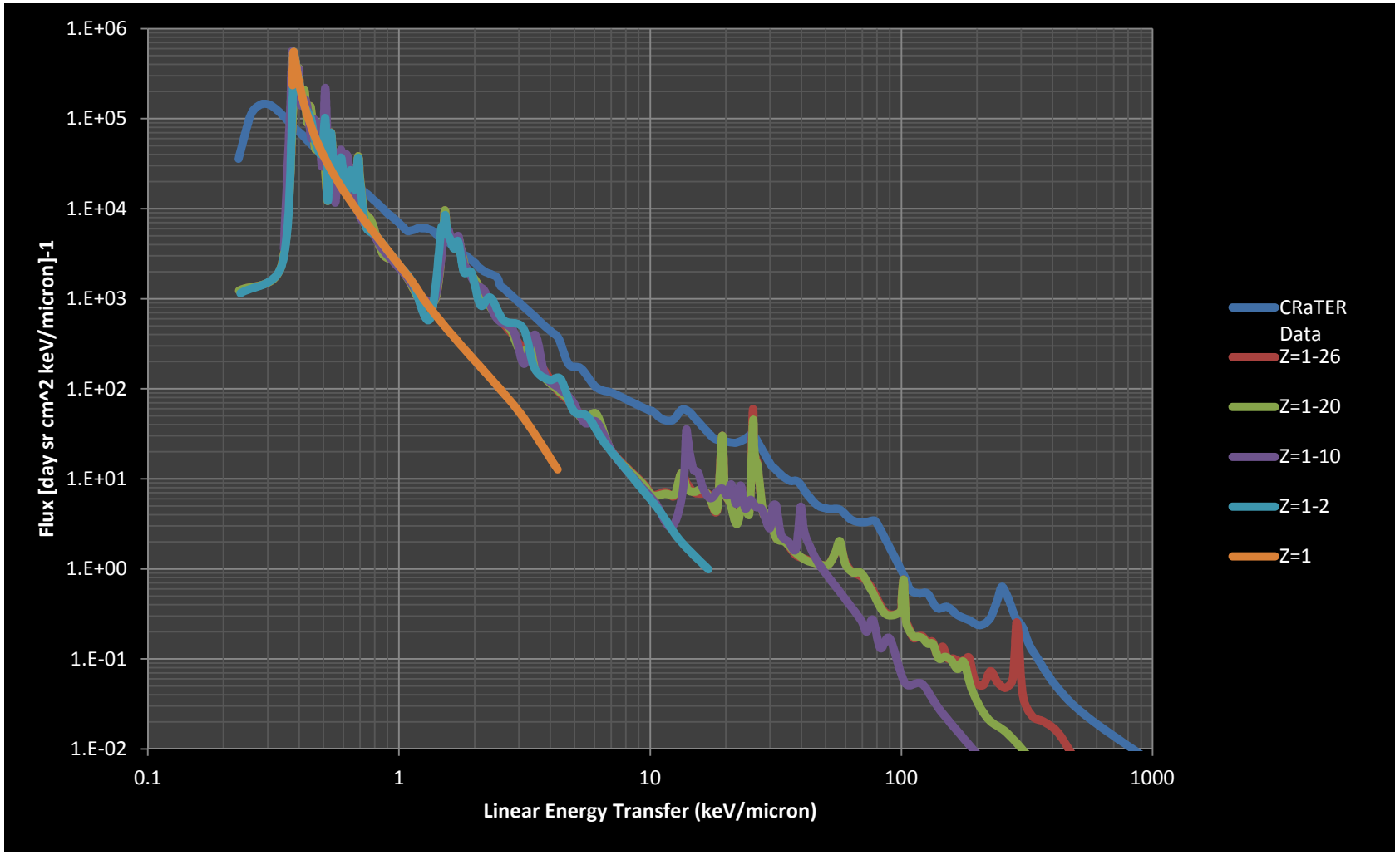


Figure 47. Breakdown of Ion Contribution (Primary and Secondary) for Detector 2

It is clear that the secondary contribution to LET from each ion occurs in the lower LET range, then shifting the proton and alpha peaks to higher LET values. The secondaries have little to no contribution higher than ~ 5 keV/micron. It also seems as if detector 2 does not represent the carbon LET contribution well in comparison to observed data. Instead of using a detector cutoff LET between the two detectors, Figure 48 compares the results using the individual ion technique as presented in Figures 46 and 47.

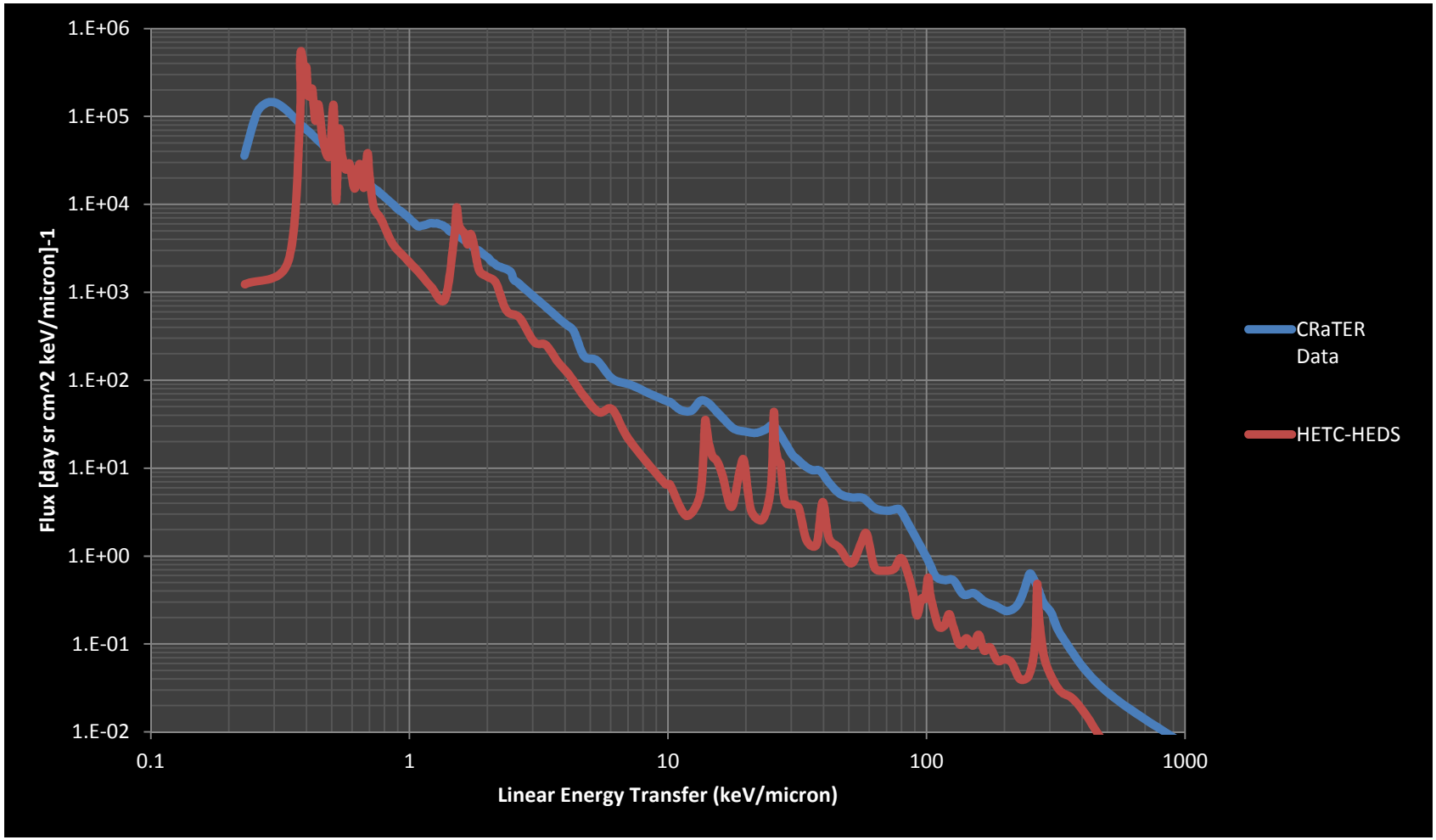


Figure 48. Individual Ion Comparison of Observed CRaTER Data and HETC-HEDS with Primary and Secondary Particles Separated

The best fit comparison gives better peak agreement in the high LETs for each ion, especially carbon (LET ~ 14 keV/micron), in comparison to the detector cutoff plot for D1/D2. Our next step is to take out secondaries completely to see if the shifts in the lower (proton and alpha) peaks are due to their contribution. Figures 49 - 51 show the results for only primary ion contributions.

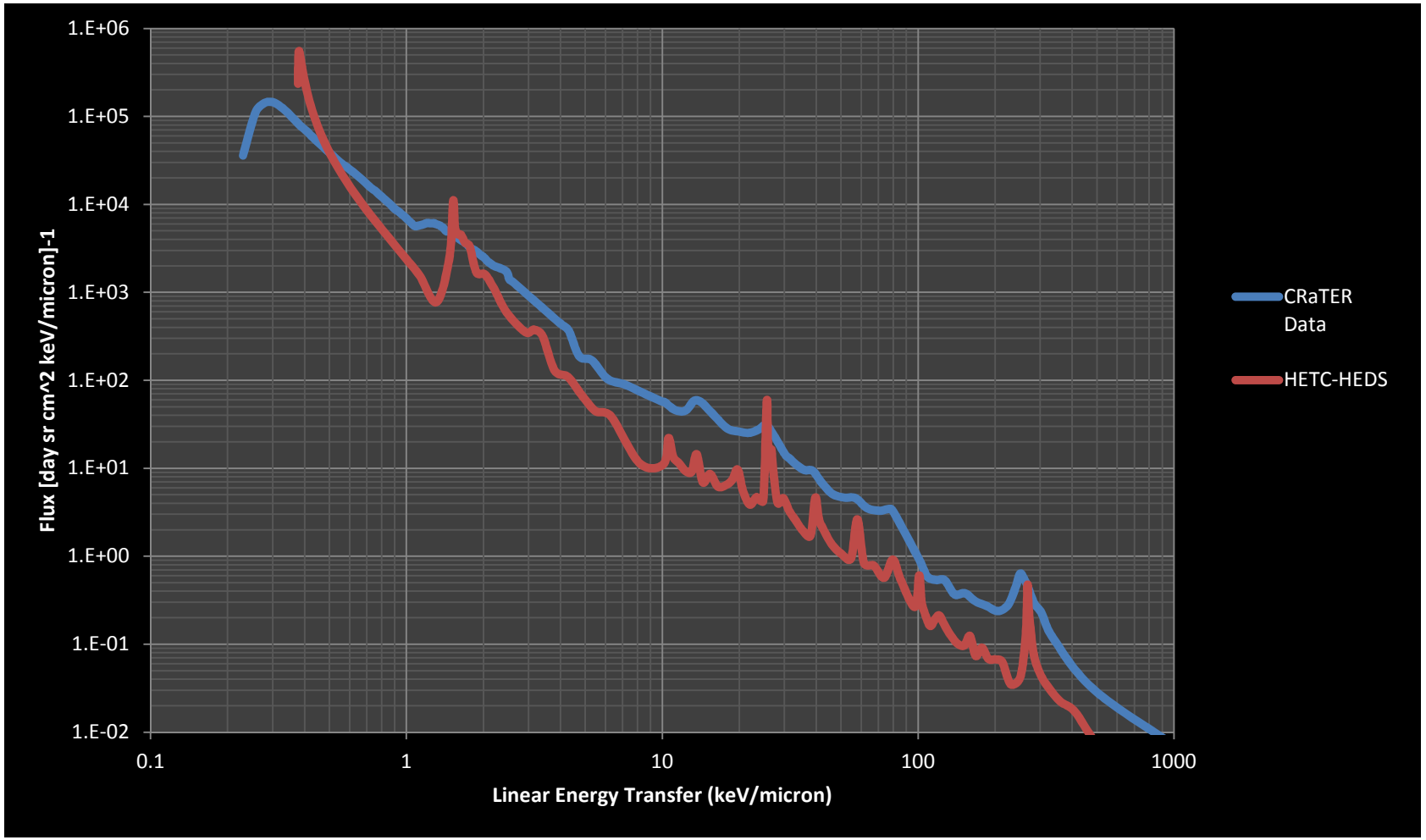


Figure 49. Detector Cutoff Comparison of Observed CRaTER Data and HETC-HEDS with only Primary Particles

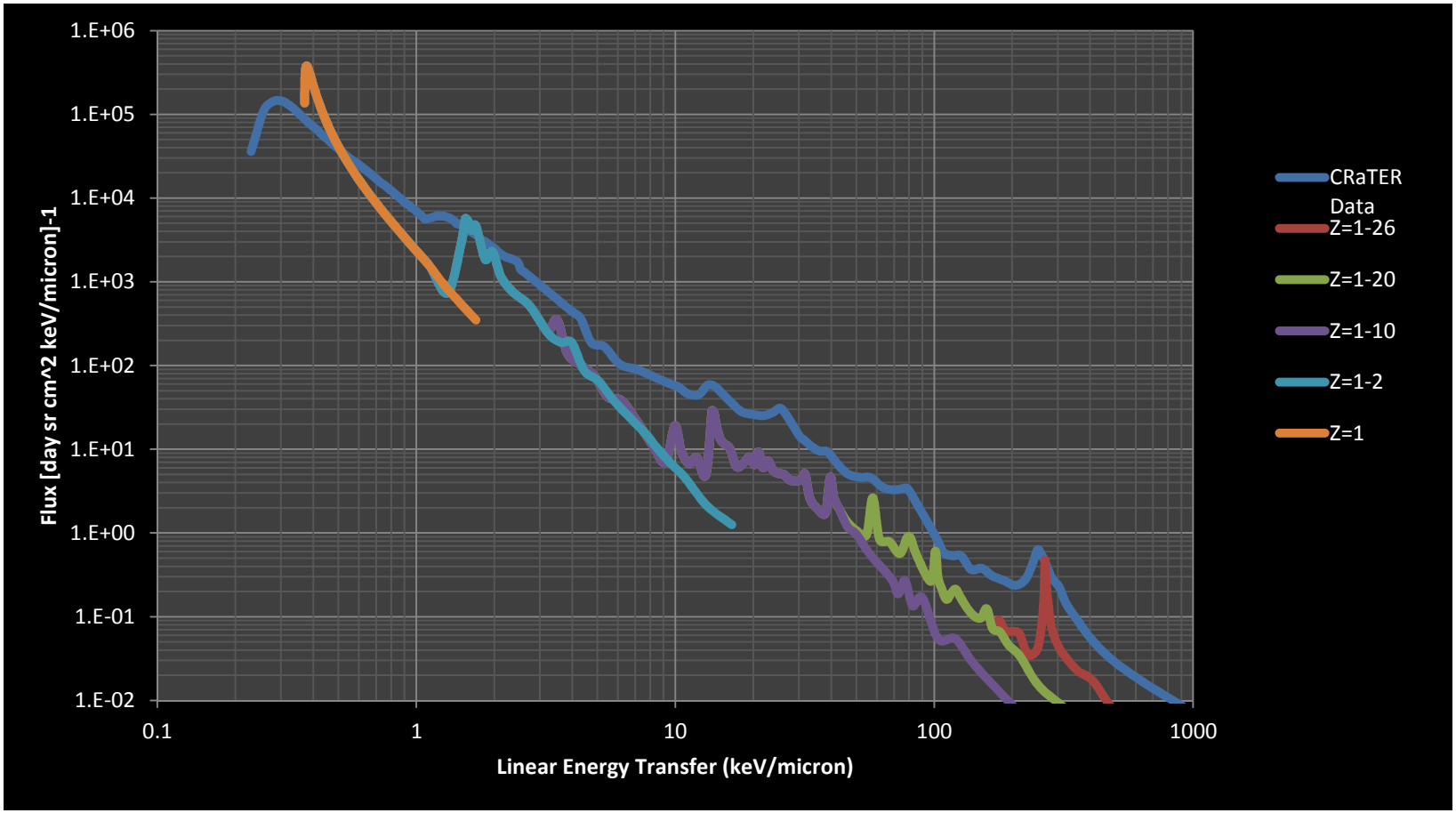


Figure 50. Breakdown of Ion Contribution (Only Primary) for Detector 1

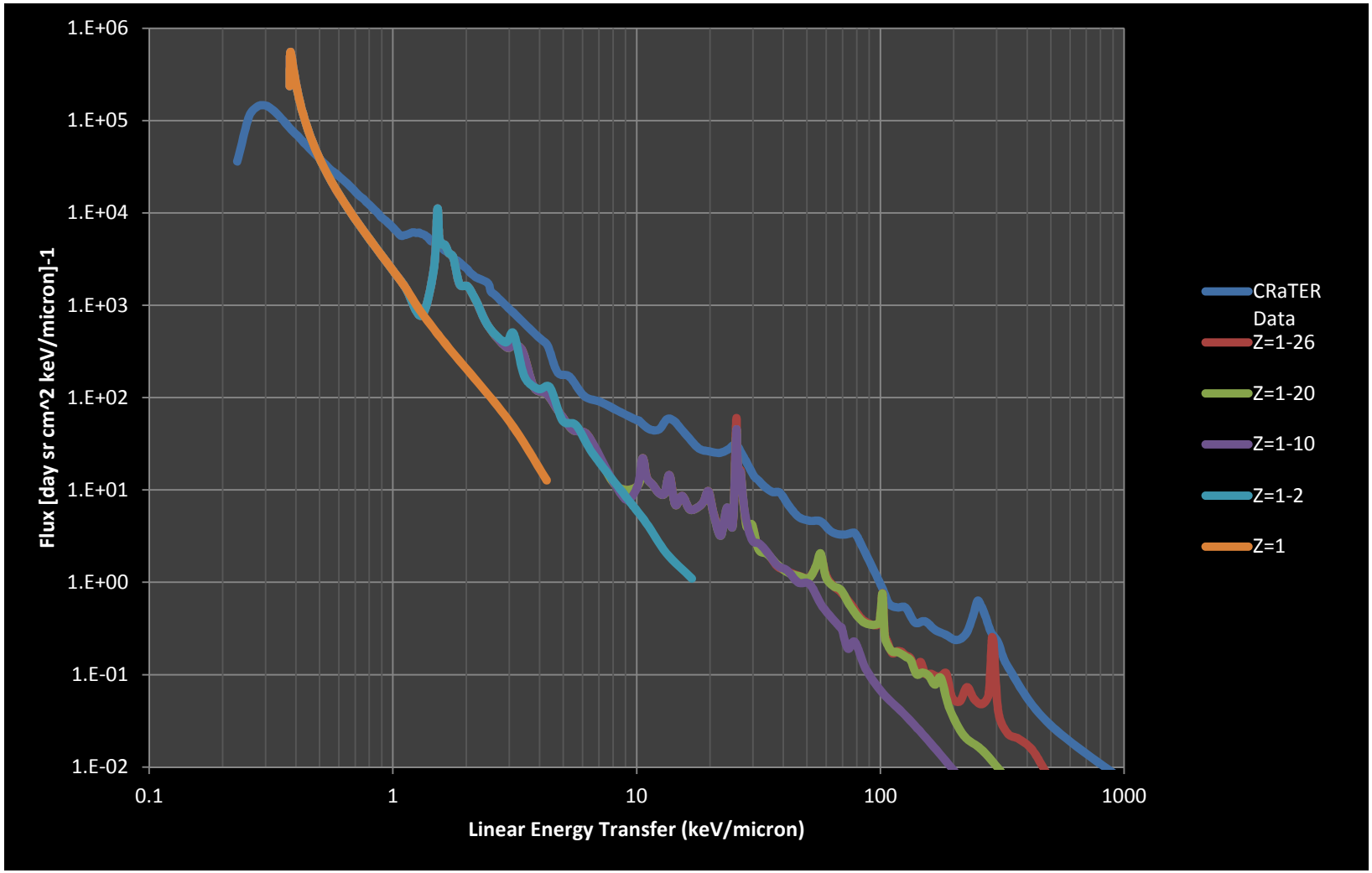


Figure 51. Breakdown of Ion Contribution (Only Primary) for Detector 2

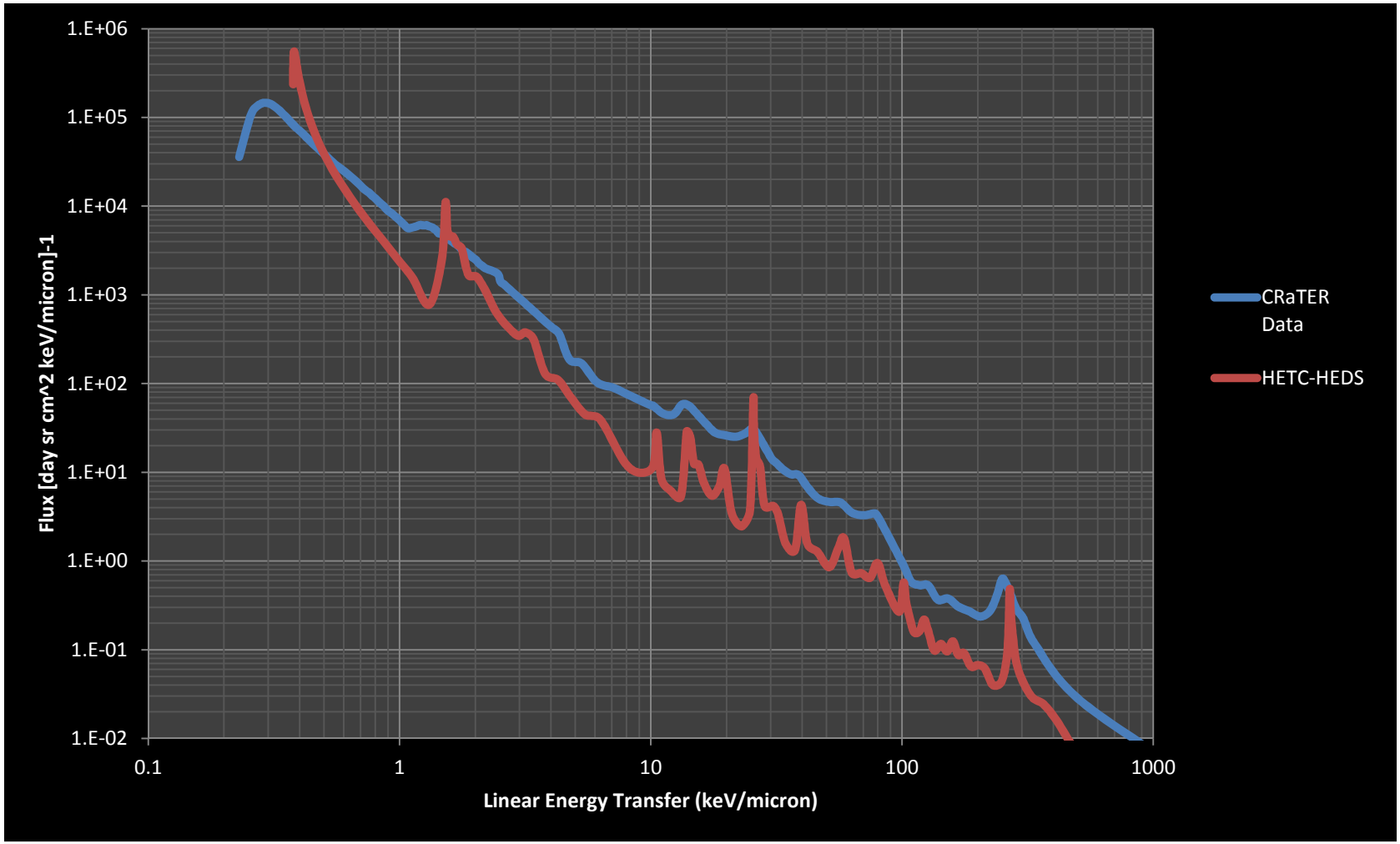


Figure 52. Individual Ion Comparison of Observed CRaTER Data and HETC-HEDS with only Primaries

Taking out the secondary particles makes the proton and alpha peaks smoother showing that the secondary contribution affects these ions considerably, though the shift in peak location is still an issue. The next step is to correct for the delta ray energy loss for protons and alphas. Presently all energy is assumed to be deposited inside the detector while in reality this is not the case [47]. Let χ represent the ratio of the mean energy lost to the maximum energy of the delta ray, as displayed in Equation 11.

$$\chi \equiv \frac{\Delta}{\epsilon_{max}} \qquad (11)$$

This is where:

Δ = mean energy lost

ϵ_{max} = Max energy imparted to an e^-

As $\chi \rightarrow 0$, energy lost in individual collisions is important. As $\chi \rightarrow$ infinity, each particle has many collisions with electrons. This equation gives you an energy loss distribution, but for this research we need an energy deposited distribution.

$$\chi' \equiv \frac{}{\epsilon_d} \qquad (12)$$

This is where:

ϵ_d = energy deposited in medium prior to escaping

□ = 0.30058 $(m_e c^2)(\frac{Z_{inc}}{\beta^2})(\frac{Z_{med}}{A_{med}})$S units in MeV [47]

m_e = mass of an electron

c = speed of light

Z_{inc} = atomic number of incoming particle

$\beta = v/c$

Z_{med} = atomic number of target

A_{med} = mass number of target medium

S = thickness of target medium (in g/cm^2)

This equation is used under the assumptions that:

(1) All e^- with energy > ϵ_d escape

(2) Only e^- with energy > ϵ_d escape

(3) Each escaping e^- deposits ϵ_d into the absorber prior to escaping

Using these assumptions:

$$\Delta^P(E) = mean\ energy\ imparted$$

$$= \{\ln\left(\frac{\epsilon_{max}\epsilon_d}{I^2}\right) - 2\beta^2 + \beta^2\left(1 - \frac{\epsilon_d}{\epsilon_{max}}\right) + 1 - \frac{\epsilon_d}{\epsilon_{max}} - \beta^2\frac{\epsilon_d}{\epsilon_{max}}\ln\left(\frac{\epsilon_{max}}{\epsilon_d}\right)\} \qquad (13)$$

$$\epsilon_{max} = \frac{2m_e c^2\beta}{1-\beta^2} \qquad (14)$$

The continuous slowing down approximation with a range of one half the detector thickness is used to determine ϵ_d. Therefore ϵ_d = 0.097 MeV is used for detector 1 while ϵ_d = 0.32 MeV is used for detector 2.

This delta ray correction was applied to protons and alphas from the HETC-HEDS simulation. The following tables show the effect on average LET for these ions.

Table 16. Delta Ray Energy Loss Corrections for Detector 1 Protons

Incoming energy (MeV)	HETC-HEDS Average LET (only Primaries)	Calculated Average LET	Ratio (Calculated/HETC-HEDS)
300	0.667678816	0.650679474	0.974539641
400	0.57740947	0.551297114	0.954776709
500	0.523448618	0.492810774	0.941469243
600	0.487767961	0.454781864	0.932373383
700	0.464048016	0.428407822	0.923197184
800	0.446231789	0.409276632	0.917183944
900	0.434369293	0.394935778	0.909216615
1000	0.42411565	0.383915171	0.905213405
1250	0.409043002	0.365504621	0.893560383
1500	0.401808884	0.354718492	0.882804006
1750	0.397320655	0.348104809	0.876130661
2000	0.396376393	0.34397152	0.867790127
2250	0.395858649	0.341401339	0.862432434
2500	0.394956451	0.339859347	0.860498281
2750	0.398227671	0.339015875	0.851311699
3000	0.398109296	0.338658757	0.850667796

Table 17. Delta Ray Energy Loss Corrections for Detector 2 Protons

Incoming energy (MeV)	HETC-HEDS Average LET (only Primaries)	Calculated Average LET	Ratio (Calculated/HETC-HEDS)
500	0.521898327	0.521307939	0.998868769
600	0.486306657	0.48147666	0.990068001
700	0.462623158	0.453868335	0.981075694
800	0.444794447	0.433855018	0.975405651
900	0.432990179	0.418862872	0.967372685
1000	0.422770552	0.407348905	0.963522419
1250	0.407737459	0.388130135	0.951911892
1500	0.400461515	0.376878689	0.94111088
1750	0.395891202	0.369978635	0.934546241
2000	0.395066343	0.365660521	0.925567381
2250	0.394388917	0.362966778	0.920327023
2500	0.395720956	0.361339962	0.913118085
2750	0.397216639	0.360437081	0.907406804
3000	0.398048338	0.360037734	0.904507567

Table 18. Delta Ray Energy Loss Corrections for Detector 1 Alphas

Incoming energy (MeV)	HETC-HEDS Average LET(only Primaries)	Calculated Average LET	Ratio (Calculated/HETC-HEDS)
300	2.651121466	2.592321393	0.977820679
400	2.291105892	2.197497098	0.959142529
500	2.07425425	1.965218319	0.947433671
600	1.939891919	1.814238213	0.93522644
700	1.837912534	1.709568273	0.930168461
800	1.77749248	1.633673064	0.919088594
900	1.728697081	1.576805986	0.912135506
1000	1.689248176	1.53312526	0.907578461
1250	1.624877534	1.460217264	0.898662966
1500	1.597484426	1.417570197	0.887376537
1750	1.575875736	1.391474095	0.882984656
2000	1.575431534	1.375211012	0.87291068
2250	1.576009027	1.365140364	0.866200853
2500	1.566654615	1.359139973	0.867542826
2750	1.571423142	1.355902479	0.862850013
3000	1.584727486	1.354586879	0.85477591

Table 19. Delta Ray Energy Loss Corrections for Detector 2 Alphas

Incoming energy (MeV)	HETC-HEDS Average LET (only Primaries)	Calculated Average LET	Ratio (Calculated/HETC-HEDS)
600	1.927214696	1.920761198	0.996651386
700	1.826882115	1.811203239	0.991417686
800	1.759983239	1.731815992	0.98399573
900	1.711694393	1.672371705	0.977027039
1000	1.67592168	1.626739496	0.97065365
1250	1.617009585	1.550636697	0.958953312
1500	1.582056397	1.506152107	0.952021755
1750	1.570365324	1.478926256	0.941772105
2000	1.560776194	1.461934759	0.936671616
2250	1.562973178	1.451377657	0.928600489
2500	1.563347045	1.445043688	0.924326875
2750	1.571685698	1.441572848	0.917214459
3000	1.57925085	1.440091607	0.911882749

An updated curve fit analysis was done for primary protons and primary alphas. The updated LET tables can be found in the Appendix. Figures 53 - 56 include this delta ray correction with only primary contribution.

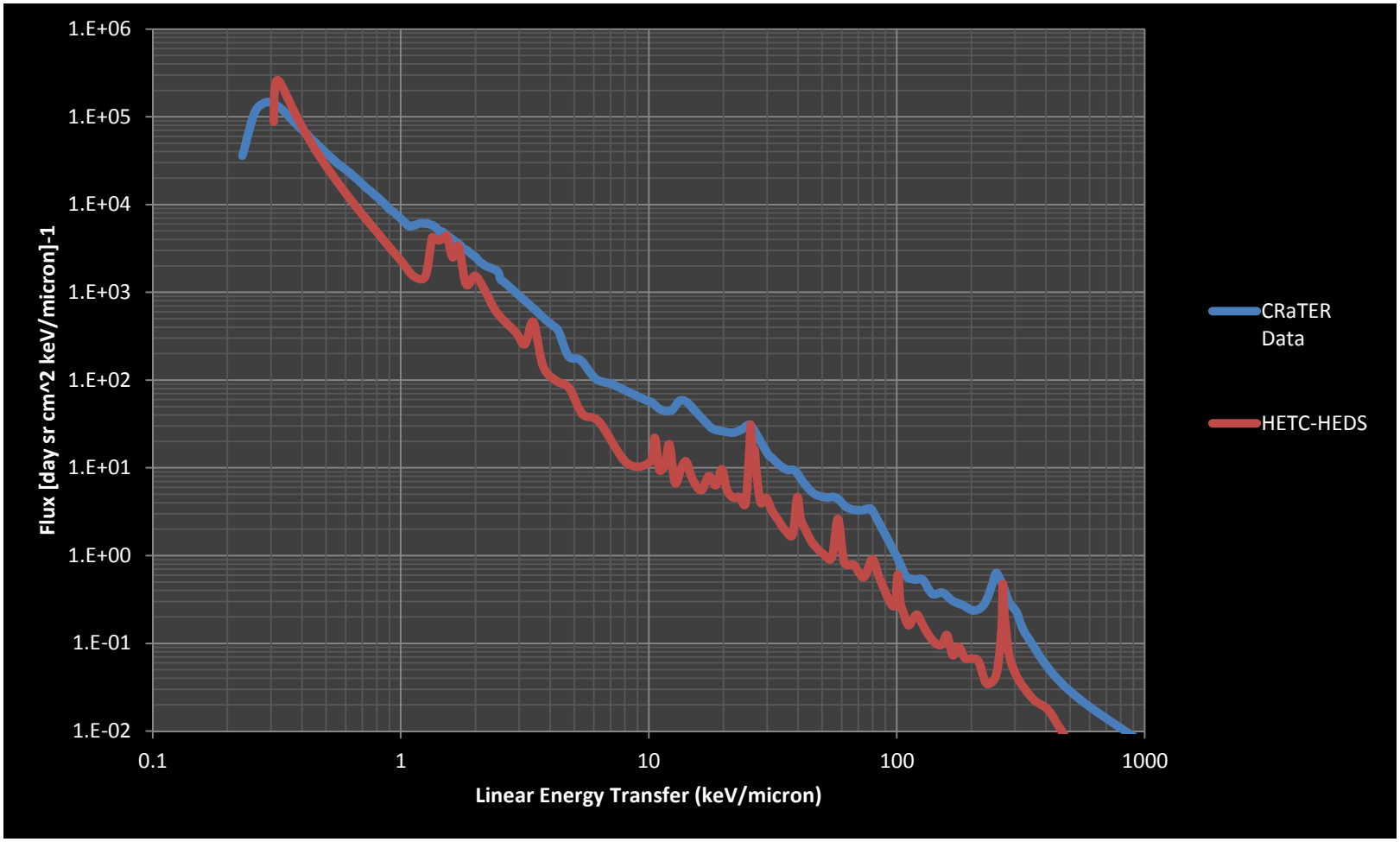


Figure 53. Detector Cutoff Comparison of Observed CRaTER Data and HETC-HEDS with Delta Ray Corrections for only Protons and Alphas (Only Primaries for Z=1-26 as displayed)

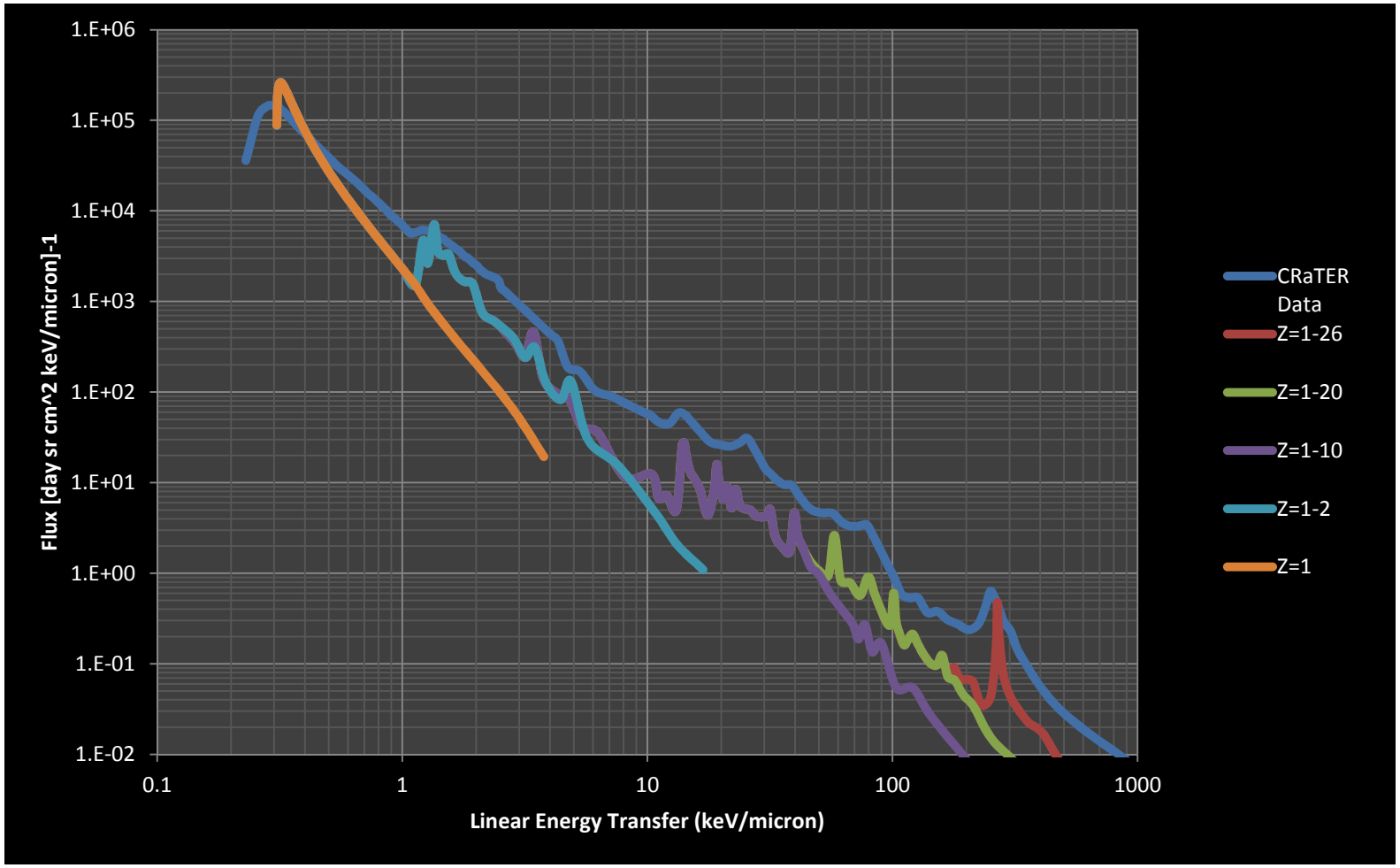


Figure 54. Individual Ion Contribution (Delta Ray Correction for only Protons and Alphas with Primaries for Z=1-26 only as displayed) for Detector 1

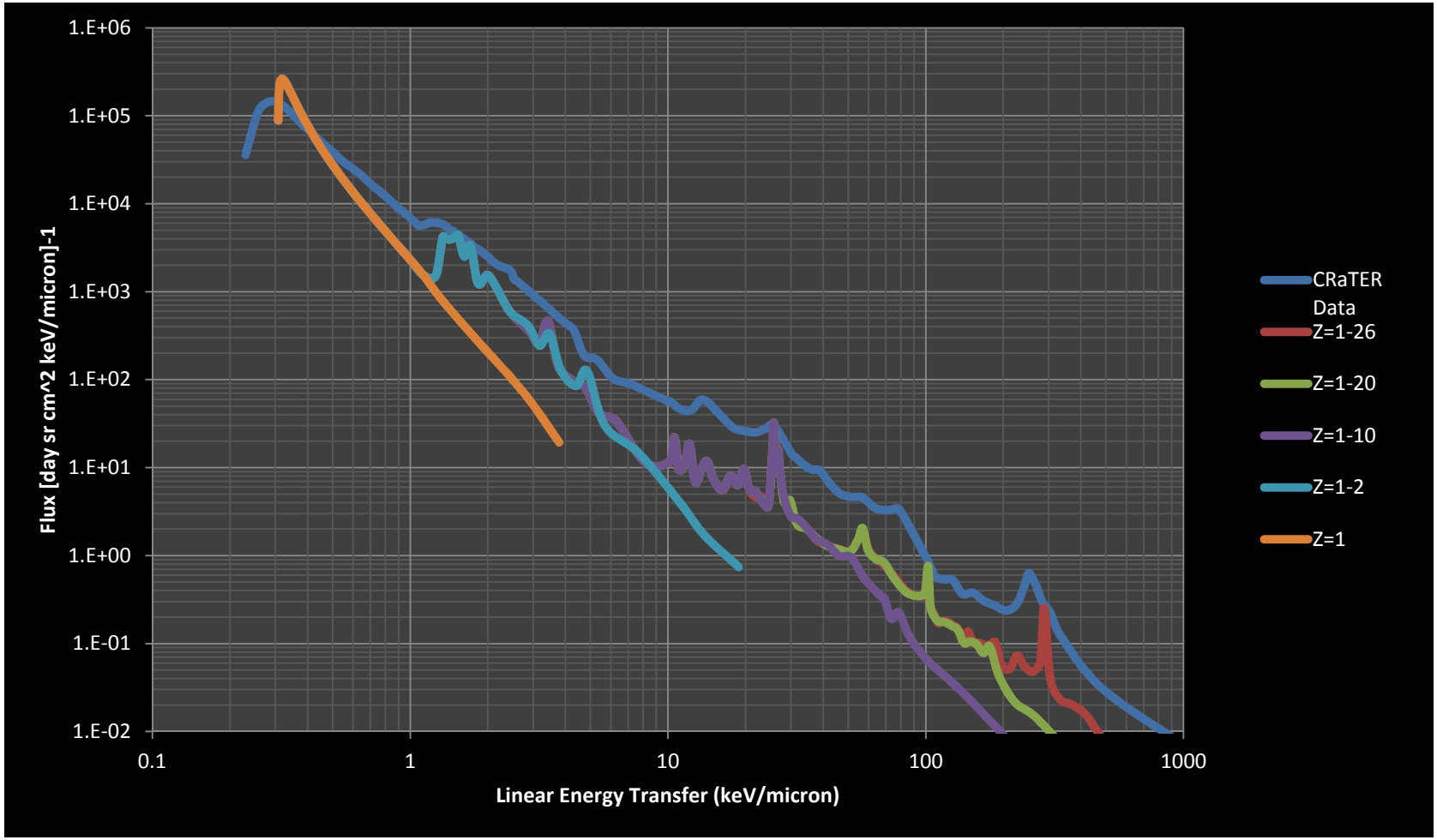


Figure 55. Individual Ion Contribution (Delta Ray Correction for only Protons and Alphas with Primaries for Z=1-26 as displayed) for Detector 2

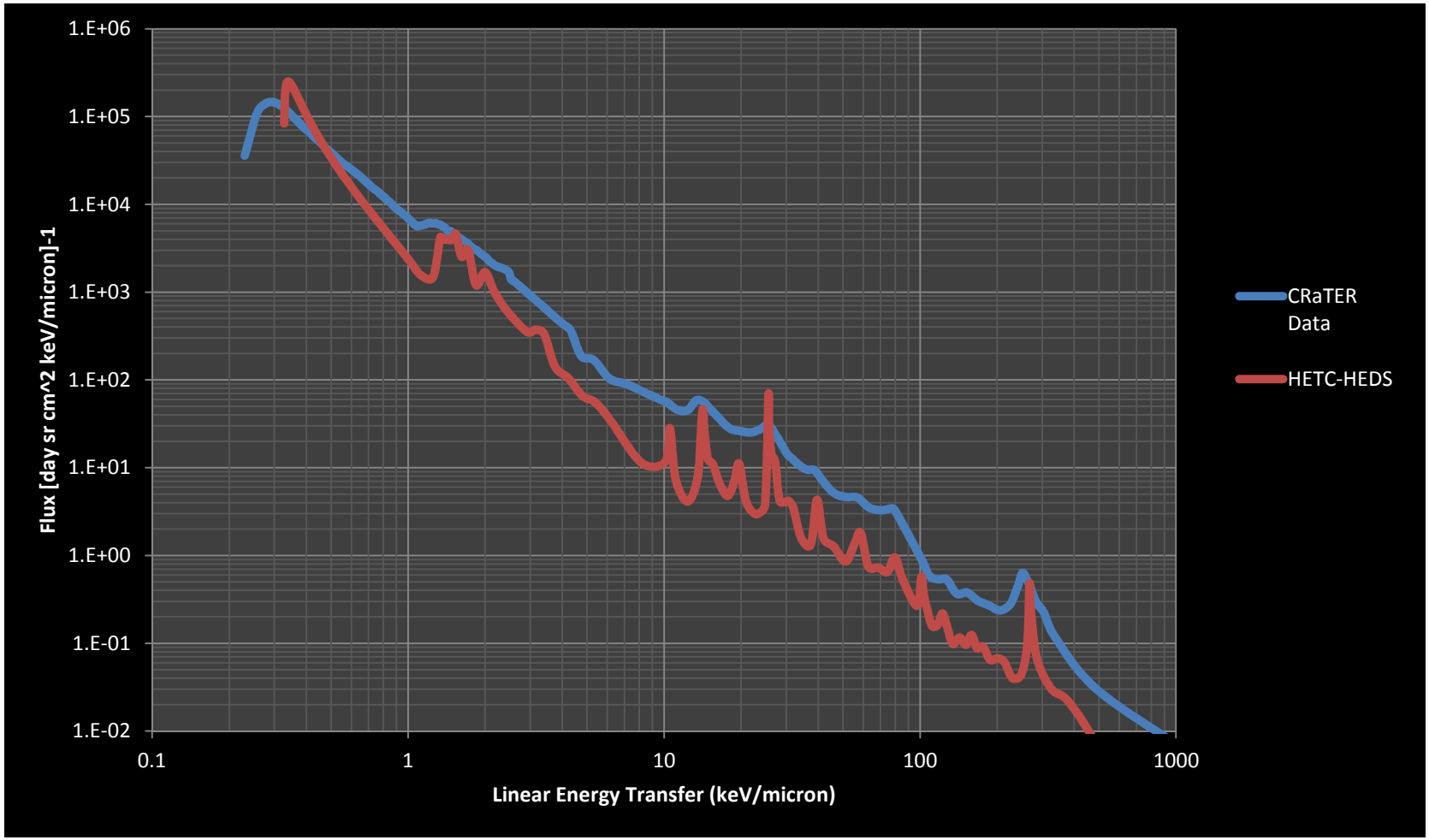


Figure 56. Individual Ion Comparison of Observed CRaTER Data and HETC-HEDS with Delta Corrections for only Protons and Alphas (Only Primaries for Z=1-26 as displayed)

This delta ray correction has shifted the HETC-HEDS proton peak to ~ 0.32 keV/micron. This is closer to the minimizing ionizing value of protons is ~0.37 keV/micron obtained from the Bethe-Bloch formula. Removing the delta ray energy deposition brings the HETC-HEDS simulated data to within ~ 0.02 keV/micron of the observed CRaTER data. The magnitude of protons still remains too high. This could be caused by binning techniques. Since the secondary particle contributions have been removed and the corrected HETC-HEDS LET value is still higher than the CRaTER observed data, it is clear that they are not the only contribution to the peak shift. Overall, removing secondary particles and making a delta ray escape correction gives positive results in the observed to simulated data comparison since the peaks are much closer to being in agreement with each other. There is a small uncertainty in the deposited energy of each event in the observed CRaTER data of ~5% in the thin silicon detectors and less than 5% in the thick silicon detectors. The observed CRaTER flux magnitude is still under investigation as there still remains some uncertainty in the overall LET spectra normalization.

6.2. HZETRN vs. Observed CRaTER Data

HZETRN is a true LET calculation. The code reads Badhwar O'Neill data directly as input. The 2010 average fluxes from Badhwar-O'Neill for each ion were also used for this comparison. The code output gives LET vs. differential flux directly. Figure 59 shows the output comparison between detector 1 and detector 2.

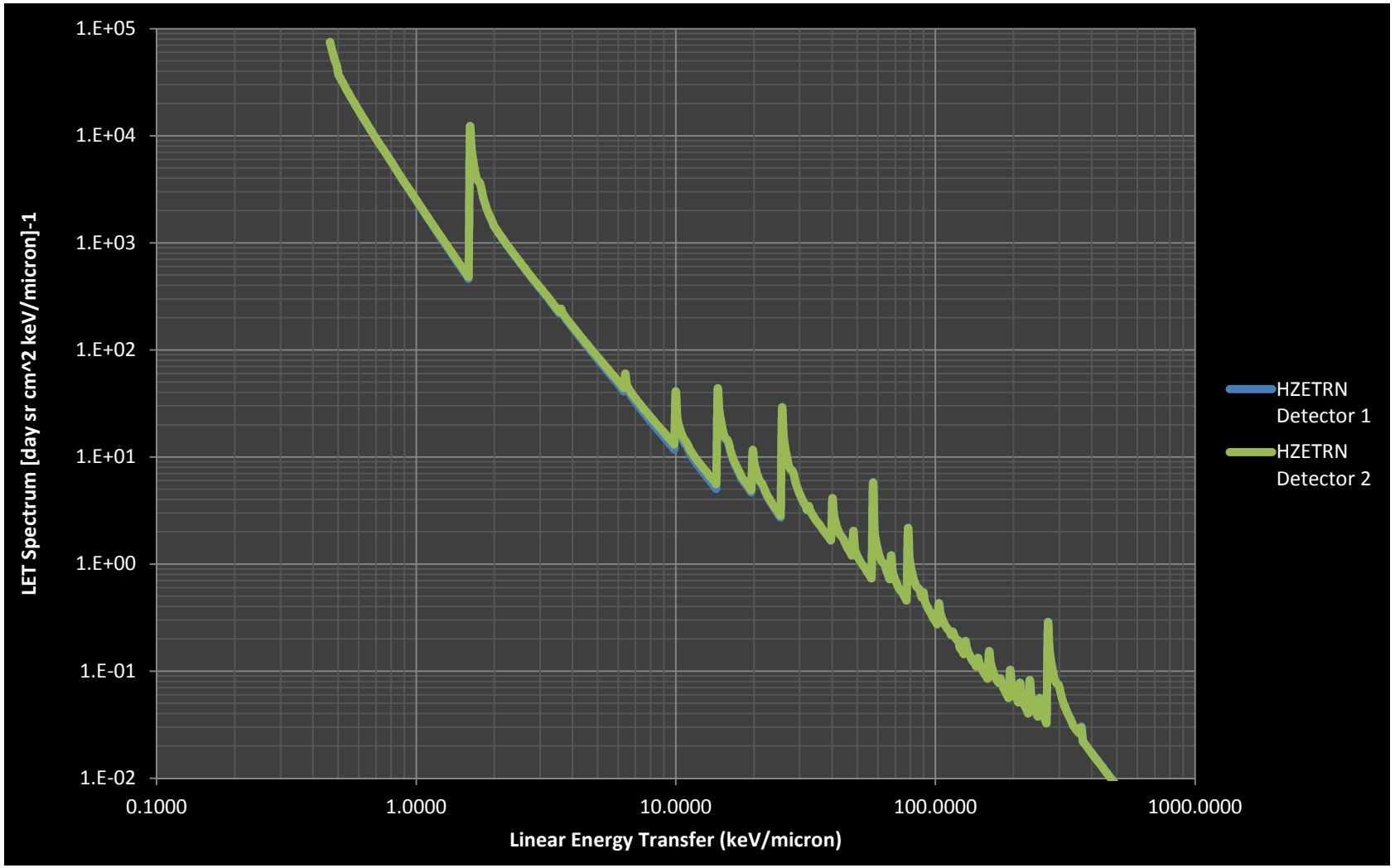


Figure 57. HZTERN Detector 1 and Detector 2 Comparison

It's clear that detector 1 and detector 2 are almost identical in HZETRN. This is expected because the small thickness of the detectors means that energy losses by the high energy portions of each ion's spectra are small enough that LET is unaffected. There are no delta rays escaping since the calculation is for energy losses only. Figure 60 shows the comparison to observed CRaTER data.

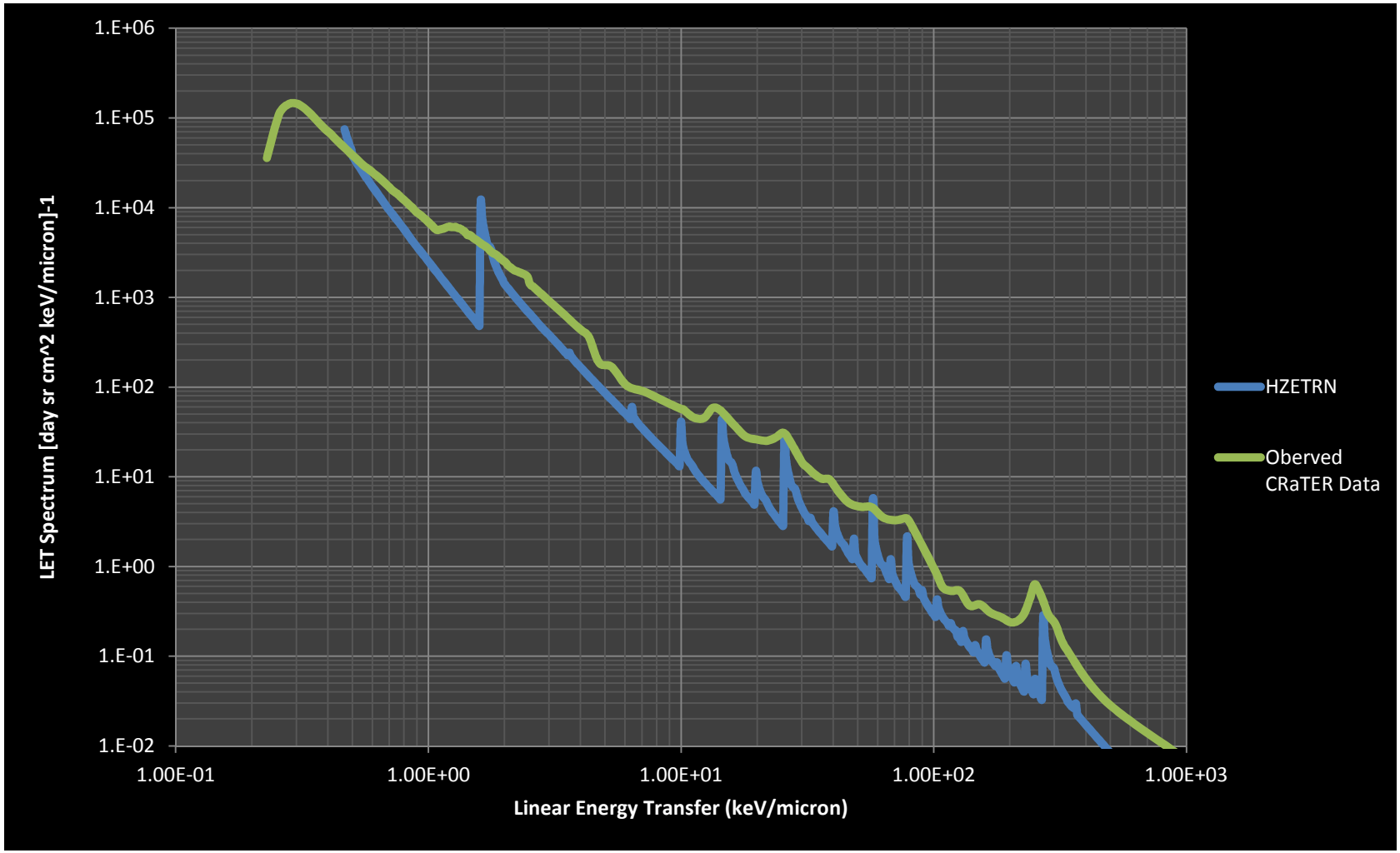


Figure 58. HZETRN vs. Observed CRaTER Data

HZETRN has much sharper peaks than the observed data because it is a true point calculation. The heavy ion peaks appear to line up well while the proton and alpha peaks seem to differ both in LET location and magnitude. These magnitude differences in the peaks could be the result of binning differences between the HZETRN and CRaTER results. This could be caused by delta rays that escape from the CRaTER detector but are not accounted for in the HZETRN results. Since the detector is modeled by infinite slabs in HZETRN, the energy loss would not be a factor and the energy deposition would be included in the LET results. In HZETRN, we are not able to remove the escaping delta ray contribution since delta rays are not produced or followed in that code. Although HETC-HEDS results are not true LETs, the next section comparing HZETRN to HETC-HEDS will display a comparison between them without the observed CRaTER data.

6.3. HETC-HEDS vs. HZETRN

Figure 61 shows the comparison of LET results from these two transport codes.

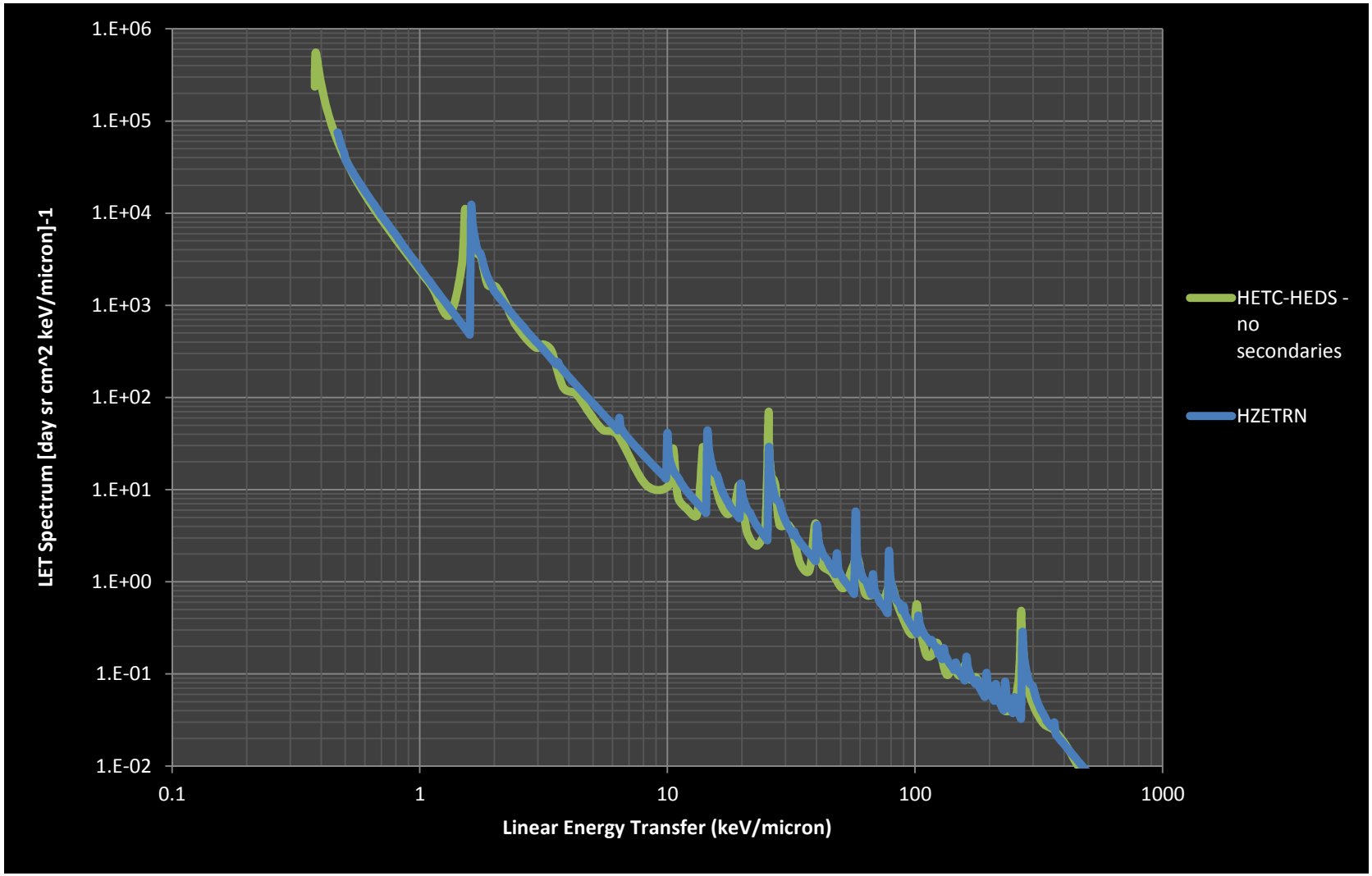


Figure 59. HZETRN vs. HETC-HEDS Data with No Secondaries

The peak locations and magnitudes of these two curves are in excellent agreement. This suggests that understanding the observed data from CRaTER is still a work in progress. One potentially significant source of difference between the CRaTER data and the LET calculations from the transport codes lies with the treatment of secondaries. In CRaTER, the energy deposited by secondaries is binned based upon the total energy detected from all particles that enter the detector while the data acquisition window is open. Hence LET values from the individual ions that deposit their energies are lumped together by CRaTER, but are separately included in the transport calculations.

7. CONCLUSION

LET results from the code HETC-HEDS were compared, using the average GCR spectra for the year 2010, to observed CRaTER data and to calculated LET values from the HZETRN 2010 space radiation transport code. The comparisons of minimizing ion peaks were very good for heavy ions ($Z \geq 3$). By removing the secondary particle LET contributions, the roughness of the problem peaks (protons and alphas) was reduced. Removing energy deposition from escaping delta rays also tended to create a downward shift in LET for the proton peak location.

HZETRN also gives a good prediction of higher LET peak values. With LET calculations from HZETRN and HETC-HEDS being much alike, there is an issue with the proton and alpha peaks that are causing the LET peaks to be shifted to a higher value than the observed CRaTER data. Again, some of this difference is caused by delta ray escape.

There are still many ongoing analyses of the observed CRaTER data, which may change its reported flux versus LET results in the future. It would be useful to see the comparison of the simulated data with a better secondary fit.

LIST OF REFERENCES

1. Townsend, L. W.; Miller, T. M.; and Gabriel, T. A.: HETC Radiation Transport Code Development for Cosmic Ray Shielding Applications in Space. Radiation Protection Dosimetry, Vol. 115, Nos. 1-4, December 2005, pp. 135-139.
2. M. B. Emmett. MORSE-CGA, a Monte Carlo radiation transport code with array geometry capability. ORNL-6174 (April 1985).
3. X-5 Data Team. CCC-710/MCNP: data libraries for MCNP. [file CCC-710_DATA.pdf] (May 2003).
4. Atoms, Radiation, and Radiation Protection, 2nd Edition, by James E. Turner, pp. 576. ISBN 0-471-59581-0. Wiley-VCH, April 1995.
5. Miller, T. M., and L. W. Townsend, “Comprehensive Cross Section Database Development for Generalized Three Dimensional Radiation Transport,” Nuclear Science and Engineering 149, 65 (2005).
6. H. W. Bertini and P. Guthrie, “Results from Medium-Energy Intra-nuclear-Cascade Calculation”, Nuclear Physics A169, 1971.
7. Guthrie, Miriam P.: EVAP-4: Another Modification of a Code To Calculate Particle Evaporation From Excited Compound
8. Nuclei. ORNL-TM-3119, U. S. Atomic Energy Commission, Sept. 10, 1970.Miller, T. M. and L. W. Townsend, “Double Differential Heavy Ion Production Cross Sections,” Radiation Protection Dosimetry 110, (2004).
9. Charara, Y.M.; Townsend, L. W.; Gabriel, T.A.; Zeitlin, C. J.; Heilbronn, L. H.; and Miller, J.: HETC-HEDS Code Validation Using Laboratory Beam Energy Loss Spectra Data. IEEE Transactions on Nuclear Science, Vol. 55, No. 6, December 2008, pp. 3164-3168.
10. G. W. McKinney, et al., “MCNPX Overview,” LA-UR-06-6206 (278 KB), Proceedings of the 2006 HSSW, FNAL, IL, September 6-8, 2006.
11. Heinbockel, J. H.; Slaba, T. C.; Blattnig, S. R.; Tripathi, R. K.; Townsend, L. W.; Handler, T.; Gabriel, T. A.; Pinsky, L. S.; Redell, B.; Clowdsley, M. S.; Singleterry, R. C.; Norbury, J. W.; Badavi, F. F.; and Aghara, S. K..: Comparison of the Transport Codes HZETRN, HETC and FLUKA for a Solar Particle Event. Advances in Space Research.
12. Heinbockel, J. H.; Slaba, T. C.; Tripathi, R. K.; Blattnig, S. R.; Norbury, J. W.; Badavi, F. F.; Townsend, L. W.; Handler, T.; Gabriel, T. A.; Pinsky, L. S.; Redell, B.; and Aumann, A. R.: Comparison of the Transport Codes HZETRN, HETC and FLUKA for Galactic Cosmic Rays. Advances in Space Research.
13. Slaba, T. C.; Blattnig, S.R.; Aghara, S. K.; Townsend, L. W.; Handler, T.; Gabriel, T. A.; Pinsky, L. S.; and Reddell, B.: Coupled neutron transport for HZETRN, Radiation Measurements, Vol. 45, No. 2, February 2010, pp. 173-182, doi:10.1016/j.radmeas.2010.01.005.
14. Ferrari, A., Fasso`, A., Ranft, J., Sala, P.R.: FLUKA: a multi-particle transport code, CERN 2005-10 (2005), INFN/TC_05/11, SLAC-R-773.
15. J.E. Nealy, F.A. Cucinotta, J.W. Wilson, F.F. Badavi, Ts.P. Dachev, B.T. Tomov, S.A. Walker, G. De Angelis, S.R. Blattnig, W. Atwell, Pre-engineering spaceflight validation of environmental models and the 2005

HZETRN simulation code, Advances in Space Research, Volume 40, Issue 11, 2007, Pages 1593-1610, ISSN 0273-1177, 10.1016/j.asr.2006.12.029.
16. O'Neill, P. M., Badhwar-O'Neill galactic cosmic ray model update based on advances composition (ACE) energy spectra from 1997 to present, Advances in Space Research, 37, 1727-1733, 2006.
17. Wilson, J.W.; Badavi, F.F.; Cucinotta, F.A.; Shinn, J.L.; Badhwar, G.D.; Silberberg, R.; Tsao, C.H.; Townsend, L.W.; and Tripathi, R.K.: HZETRN: Description of a Free-Space Ion and Nucleon Transport and Shielding Computer Program. NASA TP 3495, May 1995.
18. Townsend, L. W.; Charara, Y. M.; DeLauder, N.; PourArsalan, M.; Anderson, J. A.; Fisher, C. M.; Spence, H. E.; Schwadron, N. A.; Golightly, M. J.; and Cucinotta, F. A.: Parameterizations of the Linear Energy Transfer Spectrum for the CRaTER Instrument During the LRO Mission. Space Weather – The International Journal of Research and Applications, Vol. 8, S00E03, March 2010, doi:10.1029/2009SW000526
19. Youssef, C.M., Characterization of the Cosmic Ray Telescope for the Effects of Radiation (CRaTER) detector: Thesis (Ph. D.)--University of Tennessee, Knoxville, 2009.
20. Adler, I., Trombka, J. I., Yin, Lo I., Eller, E., Schmadebeck, R. The Lunar Radiation Environment and the Implications for Future Lunar and Planetary Exploration. Interactions of the Interplanetary Plasma with the Modern and Ancient Moon. 1974. George Williams College, Williams Bay, WI.
21. Wilson, J.W.; Townsend, L.W.; Schimmerling, W.; Nealy, J.E.; Khandelwal, G.S.; Cucinotta, F.A.; Simonsen, L.C.; Khan, F.; Shinn, J.L.; and Norbury, J.W.: Transport Methods and Interactions for Space Radiations. NASA RP 1257, December 1991.
22. Cucinotta, F.A., Radiation Risk Acceptability and Limitations (unpublished).
23. Durante, M., Cucinotta, F., (2011) Physical basis of radiation protection in space travel. Reviews of Modern Physics 83:4, 1245-1281.
24. http://www.srl.caltech.edu/ACE/ACENews/ACENews83.html
25. HPS website, http://hps.org/publicinformation/radterms/radfact142.html.
26. National Research Council. Managing Space Radiation Risk in the New Era of Space Exploration. Washington, DC: The National Academies Press, 2008. 1.
27. J Feynman, A Ruzmaikin, Problems in the forecasting of solar particle events for manned missions, Radiation Measurements, Volume 30, Issue 3, June 1999, Pages 275-280, ISSN 1350-4487, 10.1016/S1350-4487(99)00055-4.
28. National Research Council. Radiation and the International Space Station: Recommendations to Reduce Risk. Washington, DC: The National Academies Press, 2000.
29. Lang, Kenneth R. The Sun from Space. New York: Springer, 2000.

30. Ojaruega, M., Nuclear Physics with Emphasis on Health: Senior Thesis – Howard University, University of the District of Columbia, 2002.
31. Cherry Jr., R.N. Chapter 48 - Radiation: Ionizing. Available from: ilocis.org/documents/chpt48e.htm.
32. NASA Space Flight Human System Standard, Volume 1: Crew Health, NASA-STD-3001, 2009.
33. ICRP, Recommendations of the International Commission on Radiological Protection, ICRP Publication 60, Annals of the ICRP, Vol. 20, Nos. 1-3, 1991.
34. Cucinotta, F.A., Space Radiation Organ Doses for Astronauts on Past and Future Missions (unpublished).
35. Vondrak, R.R., Keller, J. W., Russell, C. T., ed. Lunar Reconnaissance Orbiter Mission. Space Science Reviews, Vol. 150, Nos. 1-4, 2010, Springe.
36. LRO website, lro.gsfc.nasa.gov.
37. CRaTER Website. 2011, http://crater.sr.unh.edu/.
38. H. E. Spence, A.C., M. J. Golightly, T. Heine, J. B. Blake, P. Caranza, W. R. Crain, J. George, M. Lalic, A. Lin, M. D. Looper, J. E. Mazur, D. Salvaggio, J. C. Kasper, T. J. Stubbs, M. Doucette, P. Ford, R. Foster, R. Goeke, D. Gordon, B. Klatt, J. O'Connor, M. Smith, T. Onsager, C. Zeitlin, L. Townsend, and Y. Charara, CRaTER: The Cosmic Ray Telescope for the Effects of Radiation Experiment on the Lunar Reconnaissance Orbiter Mission. Space Science Reviews. Vol. 150: p. pp. 243-284.
39. Acquired from Tony Case., CRaTER Science Team.
40. NCRP, "Information Needed to Make Radiation Protection Recommendations for Space Missions beyond Low-Earth Orbit," Bethesda, MD, NCRP Report No. 153 (2006).
41. Badhwar & O'Neill 2010 (BO'10) Galactic Cosmic Ray (GCR) User Manual (unpublished).
42. R. M. Sternheimer and S. J. Lindenbaum. Phys. Rev. 123, 333 (1961)
43. Wilson, J.W.; Shinn, J.L.; Townsend, L.W.; Tripathi, R.K.; Badavi, F.F.; and Chun, S.Y.: NUCFRG2: A Semiempirical Nuclear Fragmentation Model. Nuclear Instruments and Methods in Physics Research, Part B, Vol. 94, 1994, pp. 95-102.
44. Cucinotta, F.A.; Townsend, L.W.; and Wilson, J.W.: Description of Alpha-Nucleus Interaction Cross Sections for Cosmic Ray Studies. NASA TP 3285, April 1993.
45. Tsao, C.H., Silberberg, R., Barghouty, A. F., Sihver, L., Energy Degradation in Cosmic-Ray Nuclear Spallation Reactions: Relaxing the Straight-ahead Approximation. Astrophysical Journal 1995. 451: p. 275.
46. Slaba, T.C., Blattnig, S. R., Badavi, F. F., Faster and more accurate transport procedures for HZETRN. Journal of Computational Physics, 2010. 229(24): p. 9397-9417.
47. Christie, W.B., Romero, J. L., Brady, F. P., Tull, C. E., Castaneda, C. M., Barasch, E. F., Webb, M. L., Drummond, J. R, Crawford, H. J., Flores, I.,

Greiner, D. E., Lindstrom, P. J., Sann, H., Young, J. C., A multiple sampling ionization chamber (MUSIC) for measuring the charge of relativistic heavy ions. Nucl.Instru.Meth., 1987. A255: p. 466-476.

APPENDIX

Table 20. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Protons from Primary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	5.942E+00	7.723E+00	1.084E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	4.564E+00	5.113E+00	2.646E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	3.784E+00	4.051E+00	3.834E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
35	3.269E+00	3.423E+00	4.891E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
40	2.897E+00	2.995E+00	5.874E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	2.614E+00	2.680E+00	6.796E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
50	2.388E+00	2.435E+00	7.687E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
55	2.206E+00	2.240E+00	8.527E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	2.054E+00	2.079E+00	9.359E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
65	1.924E+00	1.945E+00	1.016E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
70	1.813E+00	1.828E+00	1.090E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
75	1.718E+00	1.730E+00	1.163E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
80	1.633E+00	1.643E+00	1.236E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
85	1.558E+00	1.566E+00	1.302E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
90	1.492E+00	1.498E+00	1.351E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
95	1.432E+00	1.437E+00	1.118E+00	3.795E+00	4.199E+00	4.665E-01	0.000E+00	0.000E+00
100	1.377E+00	1.381E+00	9.946E-01	2.614E+00	2.697E+00	8.963E-01	0.000E+00	0.000E+00
110	1.283E+00	1.286E+00	8.562E-01	1.871E+00	1.888E+00	1.425E+00	0.000E+00	0.000E+00
120	1.205E+00	1.207E+00	7.688E-01	1.548E+00	1.551E+00	1.086E+00	1.558E+00	1.583E+00
130	1.138E+00	1.138E+00	7.042E-01	1.354E+00	1.352E+00	8.474E-01	9.756E-01	9.672E-01
140	1.079E+00	1.080E+00	6.525E-01	1.217E+00	1.214E+00	7.241E-01	7.782E-01	7.678E-01
150	1.029E+00	1.029E+00	6.118E-01	1.118E+00	1.113E+00	6.458E-01	6.709E-01	6.603E-01
160	9.849E-01	9.844E-01	5.783E-01	1.039E+00	1.034E+00	5.899E-01	5.992E-01	5.895E-01
170	9.457E-01	9.445E-01	5.476E-01	9.723E-01	9.670E-01	5.448E-01	5.463E-01	5.375E-01
180	9.100E-01	9.095E-01	5.228E-01	9.196E-01	9.131E-01	5.096E-01	5.061E-01	4.974E-01
190	8.790E-01	8.779E-01	5.019E-01	8.765E-01	8.715E-01	4.826E-01	4.762E-01	4.674E-01
200	8.504E-01	8.496E-01	4.822E-01	8.371E-01	8.317E-01	4.596E-01	4.505E-01	4.424E-01
300	6.677E-01	6.665E-01	3.670E-01	6.207E-01	6.156E-01	3.306E-01	3.166E-01	3.108E-01
400	5.774E-01	5.759E-01	3.113E-01	5.224E-01	5.180E-01	2.749E-01	2.624E-01	2.575E-01
500	5.234E-01	5.219E-01	2.784E-01	4.661E-01	4.620E-01	2.431E-01	2.310E-01	2.265E-01
600	4.878E-01	4.863E-01	2.567E-01	4.293E-01	4.255E-01	2.222E-01	2.104E-01	2.063E-01
700	4.640E-01	4.626E-01	2.411E-01	4.032E-01	3.996E-01	2.069E-01	1.962E-01	1.924E-01
800	4.462E-01	4.448E-01	2.312E-01	3.874E-01	3.838E-01	1.981E-01	1.872E-01	1.834E-01
900	4.344E-01	4.330E-01	2.241E-01	3.760E-01	3.724E-01	1.918E-01	1.815E-01	1.777E-01
1000	4.241E-01	4.228E-01	2.187E-01	3.665E-01	3.630E-01	1.866E-01	1.764E-01	1.728E-01
1250	4.090E-01	4.077E-01	2.106E-01	3.539E-01	3.501E-01	1.794E-01	1.698E-01	1.664E-01
1500	4.018E-01	4.005E-01	2.056E-01	3.462E-01	3.428E-01	1.754E-01	1.660E-01	1.628E-01
1750	3.973E-01	3.959E-01	2.035E-01	3.438E-01	3.406E-01	1.737E-01	1.640E-01	1.611E-01
2000	3.964E-01	3.951E-01	2.023E-01	3.414E-01	3.382E-01	1.724E-01	1.628E-01	1.598E-01
2250	3.959E-01	3.944E-01	2.021E-01	3.422E-01	3.389E-01	1.726E-01	1.627E-01	1.598E-01
2500	3.950E-01	3.957E-01	2.026E-01	3.420E-01	3.395E-01	1.729E-01	1.633E-01	1.604E-01
2750	3.982E-01	3.972E-01	2.035E-01	3.442E-01	3.418E-01	1.741E-01	1.641E-01	1.612E-01
3000	3.981E-01	3.980E-01	2.040E-01	3.461E-01	3.436E-01	1.748E-01	1.649E-01	1.618E-01

Table 21. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Protons from Secondary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
35	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
40	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
50	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
55	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
65	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
70	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
75	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
80	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
85	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
95	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
100	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
110	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
120	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
130	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
140	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
150	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
160	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
170	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
180	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
190	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
200	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
300	2.470E-05	1.524E-05	5.145E-05	1.015E-05	1.307E-05	2.910E-05	4.714E-06	4.648E-06
400	2.341E-04	4.425E-04	2.261E-04	3.555E-04	2.873E-04	1.313E-04	1.899E-04	4.603E-04
500	7.685E-04	8.865E-04	4.209E-04	7.134E-04	1.501E-03	4.141E-04	3.716E-04	7.191E-04
600	1.152E-03	1.473E-03	8.272E-04	1.692E-03	3.673E-03	8.349E-04	2.321E-03	1.897E-03
700	1.638E-03	1.940E-03	1.197E-03	2.647E-03	3.934E-03	1.274E-03	3.640E-03	3.327E-03
800	1.839E-03	2.548E-03	1.434E-03	3.304E-03	5.109E-03	1.490E-03	2.352E-03	2.671E-03
900	2.104E-03	2.505E-03	1.634E-03	3.570E-03	5.511E-03	1.856E-03	2.546E-03	2.816E-03
1000	1.871E-03	2.963E-03	1.945E-03	4.643E-03	6.639E-03	2.292E-03	1.025E-02	4.787E-03
1250	2.500E-03	3.581E-03	2.289E-03	6.007E-03	7.490E-03	2.747E-03	3.704E-03	5.094E-03
1500	3.694E-03	4.695E-03	2.901E-03	7.537E-03	1.033E-02	3.454E-03	7.022E-03	6.970E-03
1750	3.281E-03	4.207E-03	3.272E-03	8.917E-03	9.613E-03	3.757E-03	7.517E-03	7.646E-03
2000	3.160E-03	5.656E-03	3.740E-03	1.041E-02	1.179E-02	4.514E-03	7.419E-03	9.908E-03
2250	3.313E-03	4.999E-03	3.928E-03	1.170E-02	1.315E-02	4.803E-03	8.697E-03	1.177E-02
2500	3.882E-03	5.287E-03	4.446E-03	1.329E-02	1.634E-02	5.640E-03	1.731E-02	1.045E-02
2750	4.569E-03	6.350E-03	4.729E-03	1.448E-02	1.772E-02	6.192E-03	1.397E-02	1.392E-02
3000	4.649E-03	6.235E-03	5.053E-03	1.579E-02	1.899E-02	7.005E-03	1.205E-02	1.549E-02

Table 22. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Alphas from Primary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	2.365E+01	3.076E+01	5.036E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	1.818E+01	2.045E+01	1.138E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	1.496E+01	1.598E+01	1.613E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
35	1.291E+01	1.342E+01	2.021E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
40	1.145E+01	1.176E+01	2.384E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	1.033E+01	1.052E+01	2.714E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
50	9.436E+00	9.570E+00	3.022E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
55	8.734E+00	8.819E+00	3.302E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	8.118E+00	8.172E+00	3.563E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
65	7.610E+00	7.657E+00	3.803E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
70	7.176E+00	7.205E+00	4.016E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
75	6.799E+00	6.812E+00	4.204E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
80	6.459E+00	6.477E+00	4.373E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
85	6.168E+00	6.169E+00	4.533E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
90	5.908E+00	5.901E+00	4.662E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
95	5.664E+00	5.670E+00	3.647E+00	1.201E+01	1.310E+01	1.767E+00	0.000E+00	0.000E+00
100	5.450E+00	5.449E+00	3.275E+00	8.496E+00	8.676E+00	3.081E+00	0.000E+00	0.000E+00
110	5.084E+00	5.076E+00	2.855E+00	6.213E+00	6.205E+00	4.514E+00	0.000E+00	0.000E+00
120	4.770E+00	4.765E+00	2.588E+00	5.190E+00	5.161E+00	3.131E+00	4.243E+00	4.235E+00
130	4.507E+00	4.491E+00	2.380E+00	4.561E+00	4.522E+00	2.498E+00	2.767E+00	2.705E+00
140	4.275E+00	4.266E+00	2.227E+00	4.143E+00	4.100E+00	2.185E+00	2.271E+00	2.212E+00
150	4.071E+00	4.060E+00	2.093E+00	3.813E+00	3.773E+00	1.967E+00	1.974E+00	1.916E+00
160	3.905E+00	3.881E+00	1.982E+00	3.553E+00	3.518E+00	1.805E+00	1.778E+00	1.726E+00
170	3.748E+00	3.726E+00	1.889E+00	3.344E+00	3.308E+00	1.677E+00	1.632E+00	1.585E+00
180	3.611E+00	3.590E+00	1.808E+00	3.168E+00	3.133E+00	1.574E+00	1.512E+00	1.468E+00
190	3.487E+00	3.467E+00	1.730E+00	3.012E+00	2.975E+00	1.489E+00	1.426E+00	1.384E+00
200	3.366E+00	3.353E+00	1.675E+00	2.902E+00	2.864E+00	1.424E+00	1.355E+00	1.314E+00
300	2.651E+00	2.639E+00	1.268E+00	2.136E+00	2.108E+00	1.025E+00	9.546E-01	9.256E-01
400	2.291E+00	2.277E+00	1.059E+00	1.776E+00	1.748E+00	8.339E-01	7.705E-01	7.473E-01
500	2.074E+00	2.059E+00	9.416E-01	1.576E+00	1.550E+00	7.294E-01	6.709E-01	6.496E-01
600	1.940E+00	1.927E+00	8.630E-01	1.444E+00	1.420E+00	6.593E-01	6.051E-01	5.856E-01
700	1.838E+00	1.827E+00	8.108E-01	1.356E+00	1.334E+00	6.167E-01	5.642E-01	5.457E-01
800	1.777E+00	1.760E+00	7.748E-01	1.297E+00	1.277E+00	5.891E-01	5.403E-01	5.218E-01
900	1.729E+00	1.712E+00	7.526E-01	1.261E+00	1.241E+00	5.714E-01	5.214E-01	5.030E-01
1000	1.689E+00	1.676E+00	7.317E-01	1.231E+00	1.210E+00	5.511E-01	5.035E-01	4.860E-01
1250	1.625E+00	1.617E+00	7.011E-01	1.176E+00	1.161E+00	5.286E-01	4.818E-01	4.668E-01
1500	1.597E+00	1.582E+00	6.848E-01	1.153E+00	1.135E+00	5.129E-01	4.669E-01	4.532E-01
1750	1.576E+00	1.570E+00	6.778E-01	1.144E+00	1.123E+00	5.075E-01	4.634E-01	4.483E-01
2000	1.575E+00	1.561E+00	6.740E-01	1.144E+00	1.121E+00	5.057E-01	4.611E-01	4.455E-01
2250	1.576E+00	1.563E+00	6.740E-01	1.142E+00	1.121E+00	5.032E-01	4.603E-01	4.438E-01
2500	1.567E+00	1.563E+00	6.748E-01	1.144E+00	1.125E+00	5.076E-01	4.640E-01	4.485E-01
2750	1.571E+00	1.572E+00	6.759E-01	1.139E+00	1.129E+00	5.077E-01	4.642E-01	4.489E-01
3000	1.585E+00	1.579E+00	6.761E-01	1.145E+00	1.127E+00	5.053E-01	4.615E-01	4.471E-01

Table 23. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Alphas from Secondary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	2.026E-01	1.705E-01	8.707E-04	0.000E+00	2.802E-05	2.134E-05	0.000E+00	0.000E+00
35	2.648E-01	3.404E-01	1.514E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
40	2.741E-01	2.592E-01	4.349E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	2.216E-01	2.598E-01	6.822E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
50	1.540E-01	2.450E-01	9.775E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
55	1.942E-01	2.122E-01	1.268E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	1.736E-01	1.693E-01	1.630E-01	2.976E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00
65	1.277E-01	1.638E-01	1.944E-01	4.618E-02	4.423E-02	1.144E-02	2.200E-03	2.740E-03
70	3.229E-01	3.591E-01	2.236E-01	8.749E-02	8.216E-02	2.161E-02	7.306E-03	6.924E-03
75	2.703E-01	2.852E-01	2.575E-01	2.081E-01	1.947E-01	4.652E-02	2.677E-02	2.647E-02
80	2.758E-01	3.012E-01	2.708E-01	3.877E-01	3.708E-01	9.301E-02	4.324E-02	4.325E-02
85	1.664E-01	2.824E-01	1.506E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
90	2.733E-01	3.007E-01	2.602E-01	6.897E-01	7.049E-01	2.457E-01	1.521E-01	1.433E-01
95	2.093E-01	2.200E-01	2.280E-01	9.805E-01	1.050E+00	3.304E-01	2.598E-01	2.498E-01
100	2.827E-01	2.605E-01	2.014E-01	8.168E-01	8.839E-01	4.252E-01	3.739E-01	3.746E-01
110	3.051E-01	2.632E-01	1.793E-01	5.443E-01	6.221E-01	4.824E-01	6.567E-01	6.388E-01
120	2.234E-01	2.221E-01	1.736E-01	5.017E-01	6.947E-01	3.690E-01	8.958E-01	1.002E+00
130	2.040E-01	2.543E-01	1.633E-01	4.641E-01	6.434E-01	2.897E-01	7.420E-01	7.181E-01
140	2.154E-01	2.295E-01	1.448E-01	4.265E-01	5.397E-01	2.670E-01	6.045E-01	6.667E-01
150	2.211E-01	2.281E-01	1.375E-01	3.511E-01	5.492E-01	2.483E-01	5.604E-01	5.917E-01
160	2.420E-01	2.574E-01	1.313E-01	3.806E-01	5.098E-01	2.224E-01	4.510E-01	5.756E-01
170	4.274E-01	4.491E-01	1.282E-01	3.147E-01	5.136E-01	2.067E-01	4.432E-01	5.353E-01
180	5.550E-01	4.355E-01	1.243E-01	3.072E-01	4.449E-01	1.968E-01	4.059E-01	4.721E-01
190	3.793E-01	4.186E-01	1.250E-01	2.984E-01	5.013E-01	1.930E-01	4.807E-01	4.571E-01
200	5.275E-01	4.100E-01	1.257E-01	3.531E-01	6.544E-01	1.948E-01	4.434E-01	4.703E-01
300	4.179E-01	5.271E-01	2.255E-01	3.151E-01	7.109E-01	2.658E-01	4.026E-01	5.936E-01
400	4.388E-01	5.397E-01	2.427E-01	4.341E-01	7.012E-01	2.905E-01	5.990E-01	6.068E-01
500	6.216E-01	5.551E-01	2.512E-01	4.381E-01	7.215E-01	2.906E-01	5.587E-01	6.244E-01
600	5.960E-01	6.455E-01	2.542E-01	4.368E-01	8.800E-01	2.915E-01	5.208E-01	7.443E-01
700	5.597E-01	7.014E-01	2.598E-01	4.293E-01	9.275E-01	2.961E-01	6.434E-01	8.377E-01
800	7.242E-01	6.905E-01	2.517E-01	4.203E-01	8.711E-01	2.913E-01	6.424E-01	8.487E-01
900	5.276E-01	6.569E-01	2.554E-01	4.299E-01	8.482E-01	2.919E-01	5.674E-01	8.500E-01
1000	6.652E-01	6.728E-01	2.491E-01	4.442E-01	8.651E-01	2.815E-01	6.383E-01	8.126E-01
1250	6.963E-01	7.494E-01	2.396E-01	4.542E-01	8.094E-01	2.778E-01	4.588E-01	8.166E-01
1500	5.344E-01	6.919E-01	2.354E-01	3.578E-01	8.412E-01	2.749E-01	5.053E-01	7.842E-01
1750	5.392E-01	6.321E-01	2.285E-01	3.816E-01	8.455E-01	2.667E-01	4.842E-01	7.622E-01
2000	5.357E-01	6.022E-01	2.220E-01	3.336E-01	8.110E-01	2.626E-01	5.897E-01	6.686E-01
2250	5.182E-01	6.106E-01	2.162E-01	3.294E-01	7.005E-01	2.553E-01	5.317E-01	6.743E-01
2500	5.453E-01	6.089E-01	2.173E-01	3.154E-01	7.864E-01	2.582E-01	4.530E-01	6.824E-01
2750	4.668E-01	5.647E-01	2.119E-01	4.544E-01	6.994E-01	2.487E-01	5.803E-01	6.996E-01
3000	5.014E-01	5.158E-01	2.129E-01	3.573E-01	6.900E-01	2.513E-01	4.924E-01	6.438E-01

Table 24. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Lithium from Primary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	5.837E+01	9.038E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	4.299E+01	5.200E+01	1.554E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	3.474E+01	3.869E+01	2.554E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
35	2.971E+01	3.164E+01	3.400E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
40	2.616E+01	2.735E+01	4.143E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	2.350E+01	2.431E+01	4.815E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
50	2.147E+01	2.198E+01	5.455E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
55	1.980E+01	2.020E+01	6.027E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	1.840E+01	1.867E+01	6.569E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
65	1.725E+01	1.744E+01	7.081E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
70	1.623E+01	1.638E+01	7.540E+00	0.000E+00	0.000E+00	8.420E-07	0.000E+00	0.000E+00
75	1.537E+01	1.548E+01	7.993E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
80	1.459E+01	1.469E+01	8.387E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
85	1.392E+01	1.398E+01	8.781E+00	0.000E+00	0.000E+00	4.666E-08	0.000E+00	0.000E+00
90	1.331E+01	1.336E+01	9.121E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
95	1.278E+01	1.282E+01	9.449E+00	5.739E-05	5.734E-05	7.205E-05	5.874E-05	5.879E-05
100	1.229E+01	1.232E+01	9.676E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
110	1.145E+01	1.148E+01	7.664E+00	2.017E+01	2.188E+01	3.545E+00	0.000E+00	0.000E+00
120	1.074E+01	1.074E+01	6.525E+00	1.279E+01	1.297E+01	7.100E+00	0.000E+00	0.000E+00
130	1.015E+01	1.014E+01	5.888E+00	1.039E+01	1.043E+01	9.216E+00	0.000E+00	0.000E+00
140	9.633E+00	9.616E+00	5.382E+00	8.953E+00	8.958E+00	5.762E+00	1.138E+01	1.167E+01
150	9.169E+00	9.163E+00	5.013E+00	8.022E+00	7.987E+00	4.720E+00	8.085E+00	8.088E+00
160	8.785E+00	8.756E+00	4.704E+00	7.339E+00	7.299E+00	4.153E+00	6.727E+00	6.683E+00
170	8.433E+00	8.412E+00	4.459E+00	6.827E+00	6.787E+00	3.771E+00	5.949E+00	5.892E+00
180	8.123E+00	8.100E+00	4.236E+00	6.395E+00	6.357E+00	3.470E+00	5.384E+00	5.322E+00
190	7.843E+00	7.808E+00	4.054E+00	6.062E+00	6.015E+00	3.355E+00	4.981E+00	4.914E+00
200	7.581E+00	7.556E+00	3.893E+00	5.762E+00	5.720E+00	3.047E+00	4.627E+00	4.561E+00
300	5.982E+00	5.947E+00	2.939E+00	4.185E+00	4.145E+00	2.138E+00	3.171E+00	3.117E+00
400	5.147E+00	5.128E+00	2.492E+00	3.508E+00	3.468E+00	1.768E+00	2.610E+00	2.567E+00
500	4.672E+00	4.662E+00	2.238E+00	3.121E+00	3.087E+00	1.557E+00	2.287E+00	2.246E+00
600	4.362E+00	4.347E+00	2.063E+00	2.851E+00	2.823E+00	1.413E+00	2.068E+00	2.030E+00
700	4.148E+00	4.132E+00	1.957E+00	2.695E+00	2.670E+00	1.331E+00	1.937E+00	1.901E+00
800	4.008E+00	3.983E+00	1.876E+00	2.587E+00	2.559E+00	1.271E+00	1.862E+00	1.816E+00
900	3.883E+00	3.874E+00	1.812E+00	2.499E+00	2.473E+00	1.219E+00	1.774E+00	1.744E+00
1000	3.803E+00	3.786E+00	1.767E+00	2.419E+00	2.394E+00	1.182E+00	1.724E+00	1.692E+00
1250	3.675E+00	3.659E+00	1.699E+00	2.341E+00	2.316E+00	1.135E+00	1.657E+00	1.624E+00
1500	3.597E+00	3.581E+00	1.668E+00	2.300E+00	2.281E+00	1.116E+00	1.632E+00	1.600E+00
1750	3.572E+00	3.549E+00	1.645E+00	2.273E+00	2.252E+00	1.102E+00	1.620E+00	1.587E+00
2000	3.543E+00	3.533E+00	1.633E+00	2.266E+00	2.243E+00	1.097E+00	1.617E+00	1.591E+00
2250	3.567E+00	3.539E+00	1.635E+00	2.265E+00	2.245E+00	1.094E+00	1.627E+00	1.584E+00
2500	3.560E+00	3.534E+00	1.636E+00	2.282E+00	2.254E+00	1.104E+00	1.630E+00	1.601E+00
2750	3.568E+00	3.544E+00	1.639E+00	2.282E+00	2.263E+00	1.099E+00	1.623E+00	1.594E+00
3000	3.598E+00	3.567E+00	1.643E+00	2.283E+00	2.272E+00	1.103E+00	1.628E+00	1.605E+00

Table 25. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Lithium from Secondary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	5.865E-01	2.771E-01	5.852E-03	9.634E-04	4.914E-04	3.484E-04	0.000E+00	0.000E+00
35	7.041E-01	7.912E-01	2.715E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
40	5.182E-01	6.971E-01	7.323E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	3.950E-01	5.691E-01	1.272E-01	8.489E-03	7.174E-03	4.783E-03	4.441E-03	3.301E-03
50	2.746E-01	4.277E-01	1.887E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
55	2.446E-01	3.981E-01	2.577E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	3.154E-01	3.892E-01	3.351E-01	3.024E-02	2.798E-02	1.403E-02	1.546E-02	1.152E-02
65	4.379E-01	3.452E-01	4.285E-01	3.876E-02	3.651E-02	1.889E-02	2.179E-02	1.724E-02
70	2.737E-01	4.110E-01	5.211E-01	4.776E-02	4.439E-02	2.434E-02	2.503E-02	2.330E-02
75	2.746E-01	3.180E-01	6.230E-01	7.321E-02	6.757E-02	3.145E-02	3.429E-02	2.894E-02
80	2.460E-01	3.471E-01	7.137E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
85	3.020E-01	3.375E-01	8.398E-01	2.890E-01	2.540E-01	5.957E-02	5.012E-02	4.559E-02
90	2.588E-01	3.293E-01	8.261E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
95	2.158E-01	3.094E-01	9.996E-01	8.616E-01	8.643E-01	2.030E-01	7.964E-02	7.567E-02
100	2.803E-01	3.402E-01	1.074E+00	1.151E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
110	2.785E-01	3.715E-01	8.731E-01	4.163E+00	4.374E+00	9.953E-01	5.294E-01	4.913E-01
120	2.714E-01	3.327E-01	7.209E-01	2.684E+00	2.813E+00	1.750E+00	1.038E+00	1.008E+00
130	2.371E-01	2.841E-01	6.039E-01	2.127E+00	2.244E+00	2.033E+00	2.850E+00	2.655E+00
140	3.556E-01	3.065E-01	5.492E-01	1.802E+00	1.946E+00	1.541E+00	3.547E+00	3.804E+00
150	4.652E-01	3.220E-01	5.098E-01	1.598E+00	1.723E+00	1.263E+00	2.718E+00	2.774E+00
160	3.968E-01	3.954E-01	4.883E-01	1.452E+00	1.605E+00	1.088E+00	2.306E+00	2.303E+00
170	2.933E-01	4.250E-01	4.633E-01	1.387E+00	1.492E+00	9.660E-01	1.954E+00	2.042E+00
180	3.938E-01	3.665E-01	4.436E-01	1.319E+00	1.434E+00	8.873E-01	1.706E+00	1.909E+00
190	1.782E+00	1.956E+00	4.476E-01	1.239E+00	1.349E+00	8.451E-01	1.546E+00	1.619E+00
200	1.848E+00	1.847E+00	4.328E-01	1.186E+00	1.346E+00	7.728E-01	1.469E+00	1.562E+00
300	2.496E+00	2.440E+00	1.079E+00	1.690E+00	3.108E+00	1.090E+00	1.748E+00	2.296E+00
400	2.347E+00	2.537E+00	1.029E+00	1.618E+00	2.764E+00	1.036E+00	1.908E+00	2.077E+00
500	2.124E+00	2.127E+00	9.845E-01	1.475E+00	2.659E+00	1.052E+00	1.973E+00	2.062E+00
600	2.151E+00	2.389E+00	9.816E-01	1.429E+00	2.556E+00	1.026E+00	1.770E+00	2.089E+00
700	2.424E+00	2.358E+00	9.855E-01	1.356E+00	2.623E+00	1.042E+00	1.941E+00	2.242E+00
800	2.117E+00	2.309E+00	9.701E-01	1.479E+00	2.779E+00	1.036E+00	1.844E+00	2.165E+00
900	2.244E+00	2.454E+00	9.795E-01	1.370E+00	2.554E+00	1.031E+00	1.869E+00	2.069E+00
1000	2.324E+00	2.486E+00	9.713E-01	1.415E+00	2.805E+00	1.026E+00	1.781E+00	2.166E+00
1250	2.197E+00	2.459E+00	9.636E-01	1.385E+00	2.784E+00	1.035E+00	1.762E+00	2.129E+00
1500	2.329E+00	2.615E+00	9.453E-01	1.268E+00	2.615E+00	1.012E+00	2.161E+00	2.243E+00
1750	2.043E+00	2.396E+00	9.506E-01	1.412E+00	2.857E+00	1.006E+00	1.953E+00	2.176E+00
2000	2.385E+00	2.540E+00	9.400E-01	1.277E+00	2.631E+00	1.033E+00	1.824E+00	2.024E+00
2250	2.261E+00	2.331E+00	9.256E-01	1.346E+00	2.670E+00	1.018E+00	1.807E+00	2.216E+00
2500	2.247E+00	2.255E+00	9.386E-01	1.351E+00	2.534E+00	9.987E-01	1.740E+00	2.197E+00
2750	2.384E+00	2.379E+00	9.291E-01	1.395E+00	2.735E+00	1.012E+00	2.028E+00	2.242E+00
3000	2.202E+00	2.282E+00	9.392E-01	1.512E+00	2.546E+00	1.009E+00	1.808E+00	2.148E+00

Table 26. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Beryllium from Primary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	1.301E+02	8.155E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	8.428E+01	1.528E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	6.562E+01	7.943E+01	2.402E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
35	5.501E+01	6.152E+01	3.702E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
40	4.804E+01	5.159E+01	4.800E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	4.287E+01	4.517E+01	5.783E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
50	3.896E+01	4.050E+01	6.707E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
55	3.577E+01	3.692E+01	7.550E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	3.313E+01	3.400E+01	8.366E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
65	3.102E+01	3.169E+01	9.125E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
70	2.916E+01	2.970E+01	9.853E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
75	2.754E+01	2.800E+01	1.054E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
80	2.619E+01	2.650E+01	1.121E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
85	2.496E+01	2.521E+01	1.185E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
90	2.386E+01	2.404E+01	1.244E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
95	2.287E+01	2.303E+01	1.302E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
100	2.201E+01	2.214E+01	1.356E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
110	2.048E+01	2.056E+01	1.455E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
120	1.919E+01	1.927E+01	1.542E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
130	1.813E+01	1.816E+01	1.281E+01	3.922E+01	4.505E+01	3.947E+00	0.000E+00	0.000E+00
140	1.719E+01	1.719E+01	1.104E+01	2.375E+01	2.433E+01	1.002E+01	0.000E+00	0.000E+00
150	1.637E+01	1.640E+01	9.965E+00	1.891E+01	1.907E+01	1.349E+01	0.000E+00	0.000E+00
160	1.565E+01	1.565E+01	9.209E+00	1.641E+01	1.647E+01	1.304E+01	4.563E+01	6.616E+01
170	1.503E+01	1.503E+01	8.645E+00	1.475E+01	1.475E+01	9.480E+00	1.849E+01	1.889E+01
180	1.448E+01	1.445E+01	8.147E+00	1.349E+01	1.346E+01	8.100E+00	1.420E+01	1.425E+01
190	1.396E+01	1.396E+01	7.747E+00	1.257E+01	1.253E+01	7.299E+00	1.220E+01	1.213E+01
200	1.353E+01	1.352E+01	7.396E+00	1.180E+01	1.175E+01	6.673E+00	1.085E+01	1.077E+01
300	1.062E+01	1.060E+01	5.461E+00	8.144E+00	8.081E+00	4.261E+00	6.515E+00	6.394E+00
400	9.180E+00	9.146E+00	4.605E+00	6.737E+00	6.681E+00	3.477E+00	5.243E+00	5.166E+00
500	8.307E+00	8.286E+00	4.124E+00	5.986E+00	5.934E+00	3.045E+00	4.559E+00	4.490E+00
600	7.770E+00	7.728E+00	3.808E+00	5.479E+00	5.430E+00	2.774E+00	4.155E+00	4.096E+00
700	7.391E+00	7.353E+00	3.587E+00	5.134E+00	5.096E+00	2.580E+00	3.839E+00	3.780E+00
800	7.123E+00	7.090E+00	3.433E+00	4.893E+00	4.841E+00	2.454E+00	3.660E+00	3.605E+00
900	6.916E+00	6.890E+00	3.328E+00	4.739E+00	4.691E+00	2.368E+00	3.523E+00	3.463E+00
1000	6.777E+00	6.750E+00	3.239E+00	4.611E+00	4.577E+00	2.299E+00	3.420E+00	3.362E+00
1250	6.526E+00	6.511E+00	3.106E+00	4.391E+00	4.365E+00	2.186E+00	3.285E+00	3.207E+00
1500	6.406E+00	6.374E+00	3.050E+00	4.338E+00	4.301E+00	2.153E+00	3.234E+00	3.190E+00
1750	6.347E+00	6.321E+00	3.011E+00	4.307E+00	4.270E+00	2.133E+00	3.199E+00	3.142E+00
2000	6.305E+00	6.289E+00	3.002E+00	4.294E+00	4.271E+00	2.125E+00	3.204E+00	3.155E+00
2250	6.323E+00	6.297E+00	2.999E+00	4.324E+00	4.291E+00	2.140E+00	3.235E+00	3.183E+00
2500	6.349E+00	6.299E+00	3.008E+00	4.328E+00	4.287E+00	2.127E+00	3.203E+00	3.154E+00
2750	6.356E+00	6.335E+00	3.008E+00	4.354E+00	4.311E+00	2.141E+00	3.234E+00	3.172E+00
3000	6.403E+00	6.353E+00	3.016E+00	4.348E+00	4.313E+00	2.144E+00	3.242E+00	3.191E+00

Table 27. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Beryllium from Secondary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	3.113E-01	2.361E-01	3.984E-03	8.388E-04	3.972E-04	2.223E-04	5.435E-04	5.262E-05
35	7.515E-01	7.949E-01	1.670E-02	1.506E-03	8.426E-04	6.113E-04	8.006E-04	1.818E-04
40	4.419E-01	7.353E-01	5.260E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	4.248E-01	5.495E-01	1.042E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
50	4.093E-01	5.093E-01	1.616E-01	9.527E-03	8.347E-03	4.686E-03	4.084E-03	4.268E-03
55	4.721E-01	4.869E-01	2.313E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	3.541E-01	4.322E-01	3.038E-01	2.274E-02	1.741E-02	9.130E-03	1.157E-02	8.669E-03
65	3.004E-01	3.811E-01	3.826E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
70	2.776E-01	3.811E-01	4.671E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
75	3.280E-01	3.325E-01	5.676E-01	4.944E-02	4.739E-02	2.231E-02	2.142E-02	1.891E-02
80	4.330E-01	3.815E-01	6.759E-01	7.342E-02	6.750E-02	2.801E-02	2.699E-02	2.630E-02
85	3.294E-01	3.683E-01	7.738E-01	1.554E-01	1.378E-01	3.840E-02	3.374E-02	3.242E-02
90	3.727E-01	3.750E-01	8.732E-01	2.941E-01	2.688E-01	6.097E-02	3.760E-02	3.780E-02
95	3.753E-01	3.580E-01	9.658E-01	4.284E-01	4.046E-01	1.039E-01	4.965E-02	5.197E-02
100	3.598E-01	2.942E-01	1.062E+00	6.422E-01	6.008E-01	1.702E-01	6.917E-02	6.557E-02
110	2.952E-01	3.278E-01	1.185E+00	1.747E+00	1.628E+00	3.353E-01	0.000E+00	0.000E+00
120	2.535E-01	3.586E-01	1.149E+00	3.190E+00	3.057E+00	8.938E-01	5.312E-01	5.212E-01
130	3.016E-01	3.615E-01	9.335E-01	4.393E+00	4.485E+00	1.579E+00	1.109E+00	1.048E+00
140	2.310E-01	3.380E-01	7.749E-01	2.948E+00	3.134E+00	2.069E+00	2.131E+00	2.047E+00
150	3.602E-01	3.884E-01	6.752E-01	2.430E+00	2.585E+00	2.140E+00	3.099E+00	3.050E+00
160	3.083E-01	2.883E-01	6.110E-01	2.133E+00	2.209E+00	1.852E+00	4.440E+00	4.320E+00
170	4.046E-01	3.988E-01	5.685E-01	1.830E+00	1.974E+00	1.475E+00	3.180E+00	3.336E+00
180	2.774E-01	3.569E-01	5.403E-01	1.751E+00	1.852E+00	1.292E+00	2.834E+00	2.772E+00
190	3.093E-01	3.037E-01	5.178E-01	1.577E+00	1.657E+00	1.137E+00	2.461E+00	2.491E+00
200	2.580E-01	3.523E-01	5.003E-01	1.495E+00	1.660E+00	1.039E+00	2.104E+00	2.184E+00
300	1.868E+00	2.090E+00	8.961E-01	1.705E+00	3.274E+00	6.550E-01	2.160E+00	2.276E+00
400	1.932E+00	2.347E+00	8.271E-01	1.616E+00	3.144E+00	1.010E+00	2.319E+00	2.371E+00
500	1.922E+00	2.079E+00	7.927E-01	1.453E+00	2.893E+00	1.013E+00	2.338E+00	2.425E+00
600	1.965E+00	2.202E+00	7.758E-01	1.350E+00	2.911E+00	9.997E-01	2.060E+00	2.423E+00
700	1.738E+00	2.096E+00	7.926E-01	1.393E+00	2.955E+00	1.016E+00	2.090E+00	2.462E+00
800	2.120E+00	2.064E+00	7.829E-01	1.429E+00	3.029E+00	1.019E+00	2.130E+00	2.496E+00
900	2.063E+00	2.272E+00	7.809E-01	1.389E+00	2.962E+00	1.004E+00	2.240E+00	2.430E+00
1000	1.868E+00	2.137E+00	7.856E-01	1.412E+00	2.934E+00	1.011E+00	2.033E+00	2.471E+00
1250	1.816E+00	2.022E+00	7.704E-01	1.373E+00	2.851E+00	1.006E+00	2.147E+00	2.383E+00
1500	1.964E+00	1.987E+00	7.749E-01	1.379E+00	2.922E+00	9.807E-01	2.322E+00	2.630E+00
1750	2.070E+00	2.193E+00	7.504E-01	1.333E+00	2.845E+00	9.879E-01	2.338E+00	2.510E+00
2000	1.936E+00	2.232E+00	7.461E-01	1.330E+00	2.879E+00	9.603E-01	2.383E+00	2.418E+00
2250	1.949E+00	2.095E+00	7.326E-01	1.260E+00	2.766E+00	9.697E-01	2.615E+00	2.306E+00
2500	1.716E+00	1.876E+00	7.412E-01	1.458E+00	2.869E+00	9.876E-01	2.446E+00	2.405E+00
2750	1.741E+00	1.930E+00	7.326E-01	1.308E+00	2.756E+00	9.827E-01	2.770E+00	2.551E+00
3000	1.692E+00	1.917E+00	7.445E-01	1.434E+00	3.135E+00	9.870E-01	2.087E+00	2.562E+00

Table 28. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Boron from Primary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	1.497E+02	1.543E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	1.102E+02	1.590E+02	1.363E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
35	8.994E+01	1.073E+02	3.574E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
40	7.747E+01	8.622E+01	5.150E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	6.869E+01	7.395E+01	6.480E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
50	6.203E+01	6.557E+01	7.706E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
55	5.673E+01	5.935E+01	8.833E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	5.251E+01	5.445E+01	9.874E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
65	4.902E+01	5.048E+01	1.091E+01	0.000E+00	0.000E+00	7.440E-07	0.000E+00	0.000E+00
70	4.602E+01	4.710E+01	1.187E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
75	4.344E+01	4.429E+01	1.278E+01	0.000E+00	0.000E+00	2.311E-05	0.000E+00	0.000E+00
80	4.114E+01	4.195E+01	1.367E+01	0.000E+00	0.000E+00	3.418E-07	0.000E+00	0.000E+00
85	3.925E+01	3.979E+01	1.453E+01	0.000E+00	0.000E+00	1.299E-05	0.000E+00	0.000E+00
90	3.750E+01	3.799E+01	1.533E+01	0.000E+00	0.000E+00	9.024E-07	0.000E+00	0.000E+00
95	3.593E+01	3.633E+01	1.614E+01	0.000E+00	0.000E+00	2.359E-06	0.000E+00	0.000E+00
100	3.458E+01	3.488E+01	1.688E+01	0.000E+00	0.000E+00	2.349E-06	0.000E+00	0.000E+00
110	3.213E+01	3.233E+01	1.825E+01	0.000E+00	0.000E+00	9.039E-07	0.000E+00	0.000E+00
120	3.007E+01	3.030E+01	1.956E+01	0.000E+00	0.000E+00	5.721E-05	0.000E+00	0.000E+00
130	2.835E+01	2.853E+01	2.076E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
140	2.689E+01	2.703E+01	2.187E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
150	2.562E+01	2.570E+01	1.798E+01	5.344E+01	6.010E+01	6.099E+00	0.000E+00	0.000E+00
160	2.455E+01	2.455E+01	1.578E+01	3.445E+01	3.543E+01	1.342E+01	0.000E+00	0.000E+00
170	2.352E+01	2.354E+01	1.443E+01	2.796E+01	2.827E+01	1.795E+01	0.000E+00	0.000E+00
180	2.267E+01	2.267E+01	1.346E+01	2.446E+01	2.461E+01	2.139E+01	9.165E-04	1.062E-03
190	2.185E+01	2.183E+01	1.264E+01	2.196E+01	2.202E+01	1.501E+01	3.359E+01	3.558E+01
200	2.114E+01	2.115E+01	1.199E+01	2.019E+01	2.017E+01	1.260E+01	2.349E+01	2.377E+01
300	1.662E+01	1.658E+01	8.650E+00	1.309E+01	1.304E+01	6.975E+00	1.075E+01	1.062E+01
400	1.439E+01	1.431E+01	7.251E+00	1.066E+01	1.062E+01	5.543E+00	8.445E+00	8.275E+00
500	1.305E+01	1.299E+01	6.453E+00	9.349E+00	9.274E+00	4.806E+00	7.244E+00	7.108E+00
600	1.214E+01	1.211E+01	5.968E+00	8.580E+00	8.534E+00	4.381E+00	6.547E+00	6.460E+00
700	1.157E+01	1.153E+01	5.617E+00	7.991E+00	7.935E+00	4.040E+00	5.991E+00	5.937E+00
800	1.115E+01	1.111E+01	5.391E+00	7.670E+00	7.626E+00	3.865E+00	5.756E+00	5.674E+00
900	1.085E+01	1.080E+01	5.218E+00	7.422E+00	7.369E+00	3.726E+00	5.542E+00	5.477E+00
1000	1.060E+01	1.058E+01	5.078E+00	7.205E+00	7.149E+00	3.601E+00	5.337E+00	5.262E+00
1250	1.023E+01	1.020E+01	4.879E+00	6.900E+00	6.840E+00	3.448E+00	5.157E+00	5.066E+00
1500	1.000E+01	9.996E+00	4.772E+00	6.769E+00	6.734E+00	3.371E+00	5.019E+00	4.948E+00
1750	9.935E+00	9.917E+00	4.709E+00	6.700E+00	6.667E+00	3.326E+00	4.983E+00	4.901E+00
2000	9.891E+00	9.862E+00	4.699E+00	6.692E+00	6.652E+00	3.327E+00	4.990E+00	4.925E+00
2250	9.897E+00	9.865E+00	4.691E+00	6.706E+00	6.647E+00	3.322E+00	4.997E+00	4.982E+00
2500	9.889E+00	9.861E+00	4.693E+00	6.707E+00	6.661E+00	3.327E+00	5.078E+00	4.960E+00
2750	9.898E+00	9.904E+00	4.705E+00	6.757E+00	6.703E+00	3.343E+00	5.055E+00	4.971E+00
3000	9.984E+00	9.944E+00	4.727E+00	6.786E+00	6.727E+00	3.340E+00	5.028E+00	4.966E+00

Table 29. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Boron from Secondary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	2.859E-01	1.862E-01	3.142E-03	4.827E-04	1.642E-04	9.254E-05	5.273E-04	7.055E-05
35	1.075E+00	7.535E-01	1.247E-02	9.897E-04	5.792E-04	4.127E-04	0.000E+00	0.000E+00
40	8.950E-01	1.180E+00	3.297E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	6.669E-01	9.191E-01	8.797E-02	5.696E-03	3.665E-03	1.910E-03	1.473E-03	1.399E-03
50	6.910E-01	7.735E-01	1.508E-01	7.436E-03	6.158E-03	3.131E-03	0.000E+00	0.000E+00
55	6.103E-01	7.132E-01	2.231E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	5.619E-01	7.008E-01	3.133E-01	1.359E-02	1.289E-02	7.251E-03	5.298E-03	4.560E-03
65	5.756E-01	5.779E-01	3.965E-01	2.161E-02	1.957E-02	9.771E-03	7.783E-03	7.136E-03
70	4.187E-01	5.946E-01	5.010E-01	3.227E-02	2.903E-02	1.388E-02	1.320E-02	1.132E-02
75	4.209E-01	5.630E-01	6.106E-01	4.566E-02	4.265E-02	1.952E-02	0.000E+00	0.000E+00
80	5.133E-01	5.498E-01	7.204E-01	7.126E-02	6.627E-02	2.485E-02	2.277E-02	2.072E-02
85	5.017E-01	4.694E-01	8.383E-01	1.210E-01	1.092E-01	3.345E-02	2.790E-02	2.891E-02
90	5.073E-01	5.264E-01	9.604E-01	2.095E-01	1.885E-01	4.927E-02	3.306E-02	3.131E-02
95	4.457E-01	5.427E-01	1.068E+00	3.179E-01	3.054E-01	8.035E-02	4.472E-02	3.733E-02
100	4.405E-01	5.631E-01	1.199E+00	4.574E-01	4.243E-01	1.275E-01	5.884E-02	5.520E-02
110	4.372E-01	5.305E-01	1.414E+00	1.116E+00	1.037E+00	2.868E-01	1.895E-01	1.797E-01
120	4.483E-01	4.652E-01	1.543E+00	2.008E+00	1.930E+00	5.890E-01	3.925E-01	3.759E-01
130	5.562E-01	4.358E-01	9.873E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
140	4.683E-01	4.666E-01	1.490E+00	4.129E+00	3.909E+00	0.000E+00	0.000E+00	0.000E+00
150	4.801E-01	4.363E-01	1.250E+00	5.569E+00	5.967E+00	2.043E+00	2.090E+00	2.053E+00
160	4.741E-01	4.195E-01	1.046E+00	4.215E+00	4.464E+00	2.553E+00	2.687E+00	2.622E+00
170	3.545E-01	4.692E-01	9.237E-01	3.489E+00	3.698E+00	2.784E+00	3.449E+00	3.379E+00
180	5.073E-01	3.509E-01	8.393E-01	2.882E+00	3.219E+00	2.696E+00	4.615E+00	4.435E+00
190	4.154E-01	4.496E-01	8.063E-01	2.556E+00	2.770E+00	2.250E+00	5.088E+00	5.178E+00
200	3.717E-01	4.581E-01	7.610E-01	2.389E+00	2.563E+00	1.906E+00	4.461E+00	4.384E+00
300	1.690E+00	1.746E+00	6.928E-01	1.692E+00	3.570E+00	1.075E+00	2.005E+00	2.132E+00
400	1.935E+00	2.158E+00	8.600E-01	1.947E+00	3.781E+00	1.158E+00	3.260E+00	3.107E+00
500	1.783E+00	1.911E+00	8.219E-01	1.851E+00	3.679E+00	1.153E+00	2.541E+00	2.944E+00
600	1.778E+00	1.972E+00	8.002E-01	1.685E+00	3.331E+00	1.142E+00	2.981E+00	3.149E+00
700	1.907E+00	1.973E+00	7.973E-01	1.702E+00	3.747E+00	1.170E+00	2.694E+00	2.999E+00
800	2.017E+00	2.004E+00	7.936E-01	1.693E+00	3.348E+00	1.158E+00	2.886E+00	3.221E+00
900	1.661E+00	1.789E+00	7.727E-01	1.810E+00	3.696E+00	1.149E+00	2.870E+00	3.251E+00
1000	2.108E+00	1.934E+00	7.827E-01	1.695E+00	3.392E+00	1.162E+00	2.704E+00	3.262E+00
1250	1.629E+00	1.937E+00	7.678E-01	1.628E+00	3.424E+00	1.130E+00	2.634E+00	3.112E+00
1500	1.889E+00	1.891E+00	7.718E-01	1.566E+00	3.425E+00	1.134E+00	2.867E+00	3.195E+00
1750	1.786E+00	1.981E+00	7.615E-01	1.560E+00	3.719E+00	1.129E+00	2.948E+00	3.213E+00
2000	1.713E+00	1.983E+00	7.456E-01	1.963E+00	3.415E+00	1.096E+00	3.223E+00	3.213E+00
2250	1.797E+00	2.031E+00	7.501E-01	1.746E+00	3.662E+00	1.108E+00	3.260E+00	3.246E+00
2500	1.721E+00	1.946E+00	7.407E-01	1.657E+00	3.202E+00	1.097E+00	2.872E+00	3.223E+00
2750	1.760E+00	2.005E+00	7.374E-01	1.513E+00	3.504E+00	1.103E+00	2.767E+00	3.209E+00
3000	1.827E+00	1.957E+00	7.328E-01	1.541E+00	3.513E+00	1.104E+00	3.152E+00	3.264E+00

Table 30. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Carbon from Primary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	2.924E+02	1.007E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	1.802E+02	2.116E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
35	1.399E+02	2.027E+02	1.708E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
40	1.175E+02	1.418E+02	4.198E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	1.028E+02	1.158E+02	5.978E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
50	9.212E+01	1.003E+02	7.488E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
55	8.381E+01	8.948E+01	8.854E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	7.714E+01	8.137E+01	1.014E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
65	7.174E+01	7.500E+01	1.135E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
70	6.719E+01	6.955E+01	1.251E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
75	6.329E+01	6.515E+01	1.361E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
80	5.997E+01	6.151E+01	1.470E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
85	5.704E+01	5.835E+01	1.569E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
90	5.452E+01	5.555E+01	1.666E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
95	5.212E+01	5.305E+01	1.767E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
100	5.007E+01	5.078E+01	1.861E+01	0.000E+00	4.685E-04	2.355E-07	0.000E+00	0.000E+00
110	4.655E+01	4.706E+01	2.033E+01	0.000E+00	0.000E+00	1.661E-06	0.000E+00	0.000E+00
120	4.361E+01	4.390E+01	2.201E+01	0.000E+00	4.764E-05	0.000E+00	0.000E+00	0.000E+00
130	4.109E+01	4.133E+01	2.353E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
140	3.888E+01	3.909E+01	2.496E+01	0.000E+00	0.000E+00	1.529E-05	0.000E+00	1.244E-04
150	3.699E+01	3.725E+01	2.624E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
160	3.546E+01	3.557E+01	2.741E+01	0.000E+00	6.289E-04	7.618E-05	0.000E+00	0.000E+00
170	3.399E+01	3.406E+01	2.691E+01	1.914E+02	5.492E+01	7.392E-05	0.000E+00	1.487E-04
180	3.268E+01	3.275E+01	2.193E+01	5.629E+01	5.976E+01	1.180E+01	0.000E+00	0.000E+00
190	3.153E+01	3.156E+01	1.994E+01	4.235E+01	4.334E+01	1.834E+01	0.000E+00	1.027E-04
200	3.048E+01	3.053E+01	1.857E+01	3.595E+01	3.636E+01	2.308E+01	4.814E-04	2.318E-05
300	2.394E+01	2.391E+01	1.263E+01	1.953E+01	1.941E+01	1.064E+01	1.683E+01	1.664E+01
400	2.069E+01	2.060E+01	1.050E+01	1.558E+01	1.546E+01	8.116E+00	1.237E+01	1.221E+01
500	1.872E+01	1.868E+01	9.268E+00	1.344E+01	1.335E+01	6.888E+00	1.039E+01	1.024E+01
600	1.745E+01	1.742E+01	8.552E+00	1.229E+01	1.220E+01	6.246E+00	9.418E+00	9.223E+00
700	1.660E+01	1.654E+01	8.044E+00	1.149E+01	1.138E+01	5.785E+00	8.629E+00	8.497E+00
800	1.603E+01	1.592E+01	7.702E+00	1.099E+01	1.088E+01	5.490E+00	8.214E+00	8.094E+00
900	1.553E+01	1.550E+01	7.449E+00	1.059E+01	1.051E+01	5.267E+00	7.832E+00	7.757E+00
1000	1.522E+01	1.516E+01	7.240E+00	1.021E+01	1.016E+01	5.091E+00	7.565E+00	7.466E+00
1250	1.470E+01	1.466E+01	6.955E+00	9.855E+00	9.763E+00	4.853E+00	7.295E+00	7.103E+00
1500	1.440E+01	1.434E+01	6.793E+00	9.580E+00	9.522E+00	4.732E+00	7.073E+00	6.961E+00
1750	1.428E+01	1.421E+01	6.726E+00	9.540E+00	9.465E+00	4.697E+00	7.043E+00	6.967E+00
2000	1.418E+01	1.416E+01	6.705E+00	9.547E+00	9.467E+00	4.699E+00	7.031E+00	6.928E+00
2250	1.425E+01	1.416E+01	6.700E+00	9.560E+00	9.494E+00	4.704E+00	7.104E+00	6.973E+00
2500	1.425E+01	1.416E+01	6.706E+00	9.591E+00	9.506E+00	4.716E+00	7.109E+00	7.003E+00
2750	1.428E+01	1.420E+01	6.700E+00	9.583E+00	9.502E+00	4.701E+00	7.113E+00	6.993E+00
3000	1.438E+01	1.430E+01	6.729E+00	9.658E+00	9.584E+00	4.732E+00	7.126E+00	7.019E+00

Table 31. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Carbon from Secondary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	2.481E-01	1.269E-01	2.566E-03	0.000E+00	5.930E-05	8.210E-05	0.000E+00	0.000E+00
35	1.083E+00	4.568E-01	8.656E-03	9.312E-04	5.908E-04	1.871E-04	4.171E-04	4.049E-04
40	9.843E-01	1.128E+00	2.086E-02	1.695E-03	1.228E-03	6.315E-04	3.976E-04	4.570E-04
45	9.963E-01	1.321E+00	4.999E-02	2.469E-03	7.005E-04	0.000E+00	0.000E+00	0.000E+00
50	7.810E-01	1.067E+00	1.060E-01	5.080E-03	3.241E-03	1.875E-03	1.910E-03	1.713E-03
55	8.552E-01	9.634E-01	1.694E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	7.661E-01	8.936E-01	2.408E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
65	6.940E-01	7.192E-01	3.170E-01	1.216E-02	9.885E-03	5.545E-03	5.311E-03	4.503E-03
70	7.382E-01	7.735E-01	4.167E-01	2.020E-02	1.950E-02	8.477E-03	8.879E-03	6.763E-03
75	7.808E-01	6.593E-01	5.203E-01	3.539E-02	2.906E-02	1.172E-02	9.968E-03	8.795E-03
80	6.587E-01	6.693E-01	6.160E-01	5.292E-02	4.567E-02	1.417E-02	0.000E+00	0.000E+00
85	6.415E-01	6.344E-01	7.289E-01	9.790E-02	8.559E-02	2.423E-02	1.791E-02	1.738E-02
90	5.273E-01	6.394E-01	8.532E-01	1.383E-01	1.279E-01	0.000E+00	0.000E+00	0.000E+00
95	5.689E-01	5.406E-01	9.572E-01	2.125E-01	2.001E-01	5.517E-02	3.152E-02	7.565E-03
100	4.513E-01	5.126E-01	1.066E+00	2.901E-01	2.786E-01	8.450E-02	4.452E-02	4.265E-02
110	5.752E-01	5.963E-01	1.319E+00	6.937E-01	6.480E-01	1.853E-01	1.265E-01	1.242E-01
120	4.885E-01	5.743E-01	1.502E+00	1.328E+00	1.272E+00	3.865E-01	2.723E-01	2.612E-01
130	4.738E-01	5.919E-01	1.211E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
140	4.733E-01	5.479E-01	1.740E+00	2.292E+00	2.253E+00	9.694E-01	9.925E-01	9.549E-01
150	5.439E-01	6.063E-01	1.816E+00	2.883E+00	2.817E+00	0.000E+00	0.000E+00	0.000E+00
160	5.315E-01	4.854E-01	1.786E+00	3.945E+00	3.751E+00	1.558E+00	1.875E+00	1.844E+00
170	5.181E-01	5.183E-01	1.672E+00	6.527E+00	5.820E+00	1.957E+00	2.226E+00	2.197E+00
180	4.703E-01	5.102E-01	1.400E+00	5.904E+00	6.214E+00	2.540E+00	2.589E+00	2.555E+00
190	5.233E-01	4.520E-01	1.218E+00	4.712E+00	5.083E+00	3.051E+00	3.072E+00	3.030E+00
200	4.425E-01	4.948E-01	1.099E+00	4.010E+00	4.248E+00	3.299E+00	3.811E+00	3.731E+00
300	1.204E+00	1.452E+00	8.416E-01	2.262E+00	2.684E+00	1.543E+00	3.133E+00	3.125E+00
400	1.681E+00	2.020E+00	1.023E+00	2.660E+00	4.606E+00	1.415E+00	4.174E+00	3.856E+00
500	1.555E+00	2.017E+00	9.887E-01	2.247E+00	4.241E+00	1.430E+00	3.403E+00	3.711E+00
600	1.573E+00	1.905E+00	9.410E-01	2.041E+00	4.073E+00	1.397E+00	3.472E+00	3.830E+00
700	1.918E+00	1.867E+00	9.296E-01	2.122E+00	4.234E+00	1.396E+00	3.242E+00	3.775E+00
800	1.822E+00	1.864E+00	9.109E-01	2.065E+00	4.187E+00	1.371E+00	3.616E+00	3.917E+00
900	1.628E+00	1.953E+00	9.123E-01	2.033E+00	4.032E+00	1.408E+00	3.450E+00	3.889E+00
1000	1.819E+00	2.064E+00	9.107E-01	2.047E+00	4.293E+00	1.396E+00	3.958E+00	3.777E+00
1250	1.599E+00	1.964E+00	8.878E-01	1.970E+00	4.315E+00	1.354E+00	3.558E+00	3.861E+00
1500	1.518E+00	2.022E+00	8.857E-01	1.875E+00	3.787E+00	1.332E+00	3.789E+00	3.928E+00
1750	2.082E+00	2.088E+00	8.540E-01	2.025E+00	4.160E+00	1.324E+00	3.566E+00	3.786E+00
2000	2.048E+00	1.838E+00	8.406E-01	1.876E+00	4.070E+00	1.280E+00	3.960E+00	3.956E+00
2250	1.707E+00	1.977E+00	8.384E-01	1.869E+00	4.202E+00	1.278E+00	3.117E+00	3.701E+00
2500	1.562E+00	1.901E+00	8.388E-01	1.965E+00	4.089E+00	1.294E+00	3.138E+00	3.651E+00
2750	1.562E+00	1.892E+00	8.593E-01	1.993E+00	4.297E+00	1.304E+00	3.519E+00	3.918E+00
3000	1.726E+00	1.951E+00	8.423E-01	1.999E+00	3.947E+00	1.301E+00	3.788E+00	3.850E+00

Table 32. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Nitrogen from Primary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	7.974E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	2.751E+02	2.063E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
35	2.029E+02	3.167E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
40	1.665E+02	2.200E+02	3.467E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	1.441E+02	1.696E+02	5.967E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
50	1.281E+02	1.434E+02	7.918E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
55	1.159E+02	1.261E+02	9.664E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	1.065E+02	1.139E+02	1.124E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
65	9.889E+01	1.042E+02	1.272E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
70	9.230E+01	9.654E+01	1.413E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
75	8.692E+01	9.007E+01	1.545E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
80	8.219E+01	8.489E+01	1.676E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
85	7.806E+01	8.034E+01	1.802E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
90	7.460E+01	7.635E+01	1.922E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
95	7.133E+01	7.286E+01	2.034E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
100	6.836E+01	6.964E+01	2.149E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.902E-04
110	6.365E+01	6.448E+01	2.357E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
120	5.945E+01	6.004E+01	2.566E+01	0.000E+00	1.511E-04	0.000E+00	0.000E+00	0.000E+00
130	5.608E+01	5.655E+01	2.751E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
140	5.316E+01	5.342E+01	2.931E+01	0.000E+00	0.000E+00	9.849E-07	0.000E+00	0.000E+00
150	5.046E+01	5.077E+01	3.095E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
160	4.825E+01	4.853E+01	3.242E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
170	4.627E+01	4.650E+01	3.386E+01	0.000E+00	2.309E-04	0.000E+00	0.000E+00	0.000E+00
180	4.452E+01	4.462E+01	3.515E+01	0.000E+00	8.070E-05	1.723E-05	0.000E+00	0.000E+00
190	4.295E+01	4.304E+01	3.017E+01	1.022E+02	1.267E+02	5.818E+00	0.000E+00	0.000E+00
200	4.153E+01	4.157E+01	2.689E+01	6.322E+01	6.605E+01	1.729E+01	1.993E-04	3.930E-04
300	3.257E+01	3.254E+01	1.733E+01	2.711E+01	2.700E+01	1.512E+01	2.452E+01	2.431E+01
400	2.814E+01	2.806E+01	1.418E+01	2.094E+01	2.081E+01	1.098E+01	1.673E+01	1.649E+01
500	2.548E+01	2.540E+01	1.256E+01	1.810E+01	1.799E+01	9.293E+00	1.398E+01	1.379E+01
600	2.374E+01	2.368E+01	1.155E+01	1.645E+01	1.635E+01	8.333E+00	1.243E+01	1.227E+01
700	2.260E+01	2.252E+01	1.086E+01	1.535E+01	1.527E+01	7.718E+00	1.156E+01	1.133E+01
800	2.182E+01	2.165E+01	1.035E+01	1.453E+01	1.442E+01	7.250E+00	1.076E+01	1.062E+01
900	2.118E+01	2.105E+01	1.001E+01	1.401E+01	1.393E+01	6.985E+00	1.043E+01	1.018E+01
1000	2.076E+01	2.067E+01	9.750E+00	1.359E+01	1.348E+01	6.752E+00	1.003E+01	9.892E+00
1250	2.002E+01	1.990E+01	9.333E+00	1.296E+01	1.283E+01	6.391E+00	9.469E+00	9.320E+00
1500	1.959E+01	1.954E+01	9.149E+00	1.278E+01	1.267E+01	6.274E+00	9.308E+00	9.156E+00
1750	1.942E+01	1.930E+01	9.042E+00	1.267E+01	1.258E+01	6.206E+00	9.239E+00	9.100E+00
2000	1.933E+01	1.926E+01	9.018E+00	1.268E+01	1.259E+01	6.196E+00	9.232E+00	9.097E+00
2250	1.931E+01	1.927E+01	9.002E+00	1.266E+01	1.254E+01	6.200E+00	9.284E+00	9.159E+00
2500	1.933E+01	1.928E+01	9.009E+00	1.269E+01	1.260E+01	6.203E+00	9.259E+00	9.121E+00
2750	1.941E+01	1.933E+01	9.037E+00	1.276E+01	1.268E+01	6.230E+00	9.448E+00	9.199E+00
3000	1.951E+01	1.943E+01	9.029E+00	1.274E+01	1.266E+01	6.199E+00	9.389E+00	9.169E+00

Table 33.Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Nitrogen from Secondary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	2.234E-01	1.486E-01	2.724E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
35	8.973E-01	4.350E-01	9.655E-03	1.199E-03	4.289E-04	4.112E-04	1.239E-04	1.543E-04
40	1.133E+00	1.006E+00	2.468E-02	1.608E-03	1.368E-03	6.704E-04	4.707E-04	6.233E-04
45	9.019E-01	1.457E+00	4.758E-02	4.241E-03	2.519E-03	0.000E+00	0.000E+00	0.000E+00
50	8.900E-01	1.292E+00	1.061E-01	4.954E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
55	6.970E-01	1.068E+00	1.744E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	6.580E-01	9.057E-01	2.577E-01	1.039E-02	9.381E-03	4.311E-03	0.000E+00	0.000E+00
65	6.730E-01	8.918E-01	3.449E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
70	6.878E-01	8.268E-01	4.550E-01	2.245E-02	1.948E-02	8.963E-03	8.202E-03	6.894E-03
75	6.312E-01	7.887E-01	5.752E-01	3.106E-02	2.860E-02	1.195E-02	1.033E-02	9.203E-03
80	5.665E-01	8.118E-01	6.945E-01	5.212E-02	4.720E-02	1.753E-02	1.432E-02	1.387E-02
85	6.081E-01	7.979E-01	8.339E-01	7.903E-02	7.330E-02	2.256E-02	2.095E-02	1.861E-02
90	6.329E-01	6.945E-01	9.719E-01	1.329E-01	1.223E-01	3.457E-02	0.000E+00	0.000E+00
95	5.334E-01	7.899E-01	1.125E+00	2.051E-01	1.909E-01	5.470E-02	3.105E-02	2.872E-02
100	5.694E-01	6.190E-01	1.284E+00	2.894E-01	2.804E-01	8.557E-02	4.755E-02	4.328E-02
110	5.449E-01	6.834E-01	1.600E+00	6.795E-01	6.405E-01	1.860E-01	1.384E-01	1.244E-01
120	6.207E-01	6.741E-01	1.859E+00	1.161E+00	1.119E+00	3.638E-01	2.656E-01	2.657E-01
130	6.749E-01	6.341E-01	2.109E+00	1.533E+00	1.483E+00	6.025E-01	5.181E-01	4.752E-01
140	4.363E-01	6.029E-01	2.296E+00	1.949E+00	1.919E+00	8.464E-01	9.170E-01	8.830E-01
150	6.165E-01	5.609E-01	2.545E+00	2.494E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
160	5.873E-01	5.874E-01	2.700E+00	3.152E+00	3.067E+00	0.000E+00	0.000E+00	0.000E+00
170	5.467E-01	6.271E-01	2.775E+00	4.481E+00	4.234E+00	8.663E-01	0.000E+00	0.000E+00
180	4.747E-01	5.847E-01	2.766E+00	6.976E+00	6.460E+00	1.164E+00	0.000E+00	0.000E+00
190	4.673E-01	5.802E-01	2.377E+00	1.155E+01	1.215E+01	2.890E+00	2.656E+00	2.594E+00
200	6.317E-01	5.771E-01	2.049E+00	8.861E+00	9.387E+00	4.020E+00	3.144E+00	3.119E+00
300	5.455E-01	6.608E-01	1.228E+00	3.682E+00	4.103E+00	2.632E+00	5.330E+00	5.393E+00
400	1.209E+00	1.665E+00	1.312E+00	3.234E+00	5.401E+00	2.115E+00	3.951E+00	4.188E+00
500	1.826E+00	1.605E+00	1.266E+00	3.131E+00	5.354E+00	1.931E+00	4.716E+00	4.782E+00
600	1.631E+00	1.779E+00	1.188E+00	2.946E+00	5.141E+00	1.852E+00	5.195E+00	4.825E+00
700	1.470E+00	1.896E+00	1.172E+00	2.755E+00	5.382E+00	1.840E+00	4.734E+00	4.759E+00
800	1.452E+00	1.633E+00	1.147E+00	2.701E+00	5.170E+00	1.855E+00	5.074E+00	4.989E+00
900	1.578E+00	1.775E+00	1.134E+00	2.698E+00	5.060E+00	1.839E+00	5.553E+00	4.972E+00
1000	1.453E+00	1.689E+00	1.099E+00	2.646E+00	5.137E+00	1.790E+00	4.281E+00	5.156E+00
1250	1.451E+00	1.793E+00	1.099E+00	2.587E+00	5.052E+00	1.771E+00	4.583E+00	5.005E+00
1500	1.691E+00	1.884E+00	1.051E+00	2.520E+00	4.885E+00	1.722E+00	4.036E+00	4.585E+00
1750	1.464E+00	1.545E+00	1.035E+00	2.414E+00	5.198E+00	1.693E+00	4.857E+00	4.805E+00
2000	1.518E+00	1.676E+00	1.023E+00	2.414E+00	4.981E+00	1.681E+00	4.295E+00	4.765E+00
2250	1.596E+00	1.713E+00	1.008E+00	2.427E+00	4.894E+00	1.674E+00	5.233E+00	4.769E+00
2500	1.744E+00	1.654E+00	1.017E+00	2.375E+00	4.803E+00	1.683E+00	4.964E+00	5.060E+00
2750	1.349E+00	1.694E+00	1.003E+00	2.493E+00	4.910E+00	1.666E+00	4.478E+00	4.757E+00
3000	1.527E+00	1.730E+00	1.031E+00	2.479E+00	4.905E+00	1.685E+00	5.145E+00	4.941E+00

Table 34. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Oxygen from Primary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	3.291E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	4.214E+02	1.810E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
35	2.851E+02	3.248E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
40	2.276E+02	3.645E+02	1.373E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	1.942E+02	2.426E+02	5.461E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
50	1.710E+02	1.975E+02	8.052E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
55	1.542E+02	1.715E+02	1.018E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	1.414E+02	1.530E+02	1.210E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
65	1.307E+02	1.395E+02	1.390E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
70	1.221E+02	1.286E+02	1.560E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
75	1.147E+02	1.198E+02	1.720E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
80	1.082E+02	1.123E+02	1.873E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
85	1.028E+02	1.060E+02	2.021E+01	0.000E+00	7.783E-05	0.000E+00	0.000E+00	0.000E+00
90	9.805E+01	1.007E+02	2.161E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
95	9.366E+01	9.599E+01	2.296E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
100	8.979E+01	9.190E+01	2.428E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
110	8.332E+01	8.467E+01	2.684E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
120	7.797E+01	7.901E+01	2.922E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
130	7.338E+01	7.410E+01	3.147E+01	0.000E+00	9.748E-05	0.000E+00	0.000E+00	0.000E+00
140	6.956E+01	7.010E+01	3.358E+01	0.000E+00	2.561E-05	4.000E-07	0.000E+00	0.000E+00
150	6.617E+01	6.655E+01	3.549E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
160	6.321E+01	6.351E+01	3.732E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
170	6.052E+01	6.092E+01	3.903E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
180	5.829E+01	5.849E+01	4.065E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
190	5.618E+01	5.633E+01	4.213E+01	2.899E-04	2.130E-03	0.000E+00	0.000E+00	0.000E+00
200	5.443E+01	5.452E+01	4.315E+01	1.351E+02	1.393E-03	0.000E+00	0.000E+00	0.000E+00
300	4.261E+01	4.249E+01	2.263E+01	3.579E+01	3.569E+01	2.052E+01	3.448E+01	3.440E+01
400	3.674E+01	3.661E+01	1.841E+01	2.709E+01	2.689E+01	1.421E+01	2.169E+01	2.140E+01
500	3.331E+01	3.320E+01	1.623E+01	2.321E+01	2.306E+01	1.187E+01	1.777E+01	1.751E+01
600	3.104E+01	3.086E+01	1.490E+01	2.102E+01	2.088E+01	1.056E+01	1.567E+01	1.548E+01
700	2.950E+01	2.936E+01	1.398E+01	1.950E+01	1.932E+01	9.708E+00	1.439E+01	1.414E+01
800	2.847E+01	2.827E+01	1.334E+01	1.851E+01	1.835E+01	9.159E+00	1.353E+01	1.331E+01
900	2.762E+01	2.750E+01	1.288E+01	1.776E+01	1.765E+01	8.753E+00	1.287E+01	1.270E+01
1000	2.705E+01	2.690E+01	1.253E+01	1.725E+01	1.712E+01	8.452E+00	1.249E+01	1.221E+01
1250	2.607E+01	2.599E+01	1.202E+01	1.655E+01	1.648E+01	8.083E+00	1.189E+01	1.173E+01
1500	2.561E+01	2.548E+01	1.176E+01	1.620E+01	1.607E+01	7.877E+00	1.157E+01	1.139E+01
1750	2.537E+01	2.525E+01	1.164E+01	1.606E+01	1.594E+01	7.782E+00	1.146E+01	1.128E+01
2000	2.522E+01	2.511E+01	1.158E+01	1.597E+01	1.589E+01	7.754E+00	1.150E+01	1.132E+01
2250	2.525E+01	2.512E+01	1.154E+01	1.592E+01	1.582E+01	7.714E+00	1.141E+01	1.124E+01
2500	2.522E+01	2.511E+01	1.158E+01	1.609E+01	1.596E+01	7.793E+00	1.171E+01	1.143E+01
2750	2.534E+01	2.523E+01	1.158E+01	1.607E+01	1.596E+01	7.765E+00	1.150E+01	1.135E+01
3000	2.552E+01	2.537E+01	1.162E+01	1.617E+01	1.601E+01	7.766E+00	1.155E+01	1.144E+01

Table 35. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Oxygen from Secondary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	2.112E-01	1.397E-01	2.428E-03	4.107E-05	8.817E-05	1.572E-04	0.000E+00	0.000E+00
35	7.702E-01	4.205E-01	9.169E-03	5.687E-04	5.993E-04	3.426E-04	0.000E+00	0.000E+00
40	1.366E+00	9.322E-01	2.396E-02	1.280E-03	1.204E-03	4.981E-04	5.694E-04	8.903E-04
45	1.206E+00	1.595E+00	4.478E-02	2.706E-03	2.830E-03	1.159E-03	5.518E-04	7.632E-04
50	1.167E+00	1.674E+00	8.382E-02	4.407E-03	3.712E-03	1.717E-03	0.000E+00	0.000E+00
55	1.052E+00	1.507E+00	1.723E-01	5.687E-03	6.073E-03	2.547E-03	0.000E+00	0.000E+00
60	8.518E-01	1.241E+00	2.648E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
65	6.949E-01	1.081E+00	3.671E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
70	6.263E-01	9.842E-01	4.714E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
75	8.089E-01	1.022E+00	6.066E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
80	7.457E-01	9.276E-01	7.506E-01	5.658E-02	4.860E-02	1.681E-02	1.295E-02	1.259E-02
85	6.739E-01	9.298E-01	8.924E-01	9.976E-02	8.878E-02	2.493E-02	1.925E-02	1.768E-02
90	6.352E-01	8.401E-01	1.058E+00	1.404E-01	1.292E-01	3.827E-02	2.561E-02	2.446E-02
95	8.051E-01	7.870E-01	1.220E+00	2.259E-01	2.047E-01	5.945E-02	3.371E-02	3.196E-02
100	5.976E-01	7.601E-01	1.409E+00	3.085E-01	2.955E-01	9.119E-02	5.307E-02	4.845E-02
110	5.001E-01	7.445E-01	1.726E+00	6.480E-01	6.110E-01	1.888E-01	1.331E-01	1.288E-01
120	6.435E-01	7.940E-01	2.071E+00	1.139E+00	1.100E+00	3.608E-01	2.912E-01	2.740E-01
130	6.143E-01	7.001E-01	2.385E+00	1.476E+00	1.448E+00	0.000E+00	0.000E+00	0.000E+00
140	6.202E-01	7.103E-01	2.713E+00	1.843E+00	1.785E+00	8.026E-01	8.714E-01	8.460E-01
150	6.350E-01	6.572E-01	3.071E+00	2.344E+00	2.285E+00	1.022E+00	1.220E+00	1.198E+00
160	5.456E-01	7.540E-01	3.269E+00	2.981E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
170	7.042E-01	6.900E-01	3.521E+00	4.070E+00	3.901E+00	0.000E+00	0.000E+00	0.000E+00
180	5.398E-01	7.520E-01	3.681E+00	5.590E+00	5.315E+00	1.067E+00	0.000E+00	0.000E+00
190	5.893E-01	6.972E-01	3.649E+00	8.466E+00	7.899E+00	2.483E+00	2.514E+00	2.503E+00
200	6.191E-01	7.431E-01	3.341E+00	1.395E+01	1.251E+01	2.196E+00	0.000E+00	0.000E+00
300	6.325E-01	6.830E-01	1.808E+00	5.412E+00	5.833E+00	4.077E+00	8.658E+00	8.591E+00
400	1.131E+00	1.436E+00	1.741E+00	4.415E+00	4.947E+00	3.027E+00	6.086E+00	6.119E+00
500	1.407E+00	1.653E+00	1.669E+00	4.426E+00	6.758E+00	2.651E+00	5.813E+00	6.789E+00
600	1.424E+00	1.589E+00	1.556E+00	3.954E+00	6.727E+00	2.543E+00	5.862E+00	6.571E+00
700	1.507E+00	1.843E+00	1.515E+00	3.840E+00	6.404E+00	2.492E+00	5.988E+00	6.307E+00
800	1.409E+00	1.622E+00	1.490E+00	3.698E+00	6.350E+00	2.480E+00	5.678E+00	6.129E+00
900	1.430E+00	1.745E+00	1.453E+00	3.614E+00	6.008E+00	2.455E+00	5.377E+00	6.314E+00
1000	1.419E+00	1.660E+00	1.448E+00	3.579E+00	6.587E+00	2.445E+00	5.816E+00	5.963E+00
1250	1.575E+00	1.700E+00	1.395E+00	3.597E+00	5.739E+00	2.357E+00	6.075E+00	6.269E+00
1500	1.319E+00	1.935E+00	1.363E+00	3.438E+00	6.062E+00	2.315E+00	6.531E+00	5.885E+00
1750	1.274E+00	1.642E+00	1.321E+00	3.289E+00	6.153E+00	2.267E+00	5.858E+00	6.223E+00
2000	1.399E+00	1.505E+00	1.309E+00	3.348E+00	5.769E+00	2.239E+00	6.090E+00	6.012E+00
2250	1.336E+00	1.671E+00	1.310E+00	3.225E+00	5.669E+00	2.218E+00	5.801E+00	5.845E+00
2500	1.439E+00	1.535E+00	1.281E+00	3.217E+00	6.125E+00	2.199E+00	6.074E+00	5.905E+00
2750	1.552E+00	1.585E+00	1.286E+00	3.295E+00	5.712E+00	2.217E+00	6.217E+00	6.284E+00
3000	1.308E+00	1.599E+00	1.286E+00	3.335E+00	5.690E+00	2.205E+00	6.273E+00	6.137E+00

Table 36. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Fluorine from Primary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	5.994E+02	1.736E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
35	3.765E+02	3.611E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
40	2.957E+02	5.034E+02	1.193E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	2.498E+02	3.254E+02	5.516E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
50	2.194E+02	2.585E+02	8.872E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
55	1.974E+02	2.215E+02	1.156E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	1.803E+02	1.972E+02	1.390E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
65	1.665E+02	1.786E+02	1.609E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
70	1.551E+02	1.644E+02	1.811E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
75	1.457E+02	1.527E+02	2.002E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
80	1.375E+02	1.431E+02	2.186E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
85	1.305E+02	1.351E+02	2.368E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
90	1.242E+02	1.279E+02	2.532E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
95	1.189E+02	1.219E+02	2.701E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
100	1.139E+02	1.166E+02	2.855E+01	0.000E+00	2.720E-05	0.000E+00	0.000E+00	0.000E+00
110	1.055E+02	1.075E+02	3.158E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
120	9.883E+01	1.000E+02	3.448E+01	0.000E+00	4.104E-03	0.000E+00	0.000E+00	0.000E+00
130	9.299E+01	9.400E+01	3.706E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
140	8.802E+01	8.889E+01	3.953E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
150	8.377E+01	8.439E+01	4.191E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
160	8.001E+01	8.048E+01	4.405E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
170	7.671E+01	7.702E+01	4.603E+01	0.000E+00	1.362E-03	0.000E+00	0.000E+00	0.000E+00
180	7.381E+01	7.404E+01	4.777E+01	0.000E+00	5.160E-05	0.000E+00	0.000E+00	0.000E+00
190	7.121E+01	7.142E+01	4.967E+01	1.613E-04	1.331E-04	3.257E-06	0.000E+00	0.000E+00
200	6.877E+01	6.896E+01	5.112E+01	6.185E-03	2.053E-03	1.982E-07	0.000E+00	0.000E+00
300	5.382E+01	5.371E+01	2.835E+01	4.448E+01	4.436E+01	2.606E+01	4.532E+01	4.545E+01
400	4.650E+01	4.626E+01	2.294E+01	3.320E+01	3.298E+01	1.741E+01	2.661E+01	2.631E+01
500	4.209E+01	4.199E+01	2.021E+01	2.825E+01	2.806E+01	1.443E+01	2.149E+01	2.120E+01
600	3.922E+01	3.905E+01	1.852E+01	2.544E+01	2.525E+01	1.276E+01	1.883E+01	1.860E+01
700	3.733E+01	3.722E+01	1.739E+01	2.372E+01	2.356E+01	1.177E+01	1.725E+01	1.702E+01
800	3.604E+01	3.573E+01	1.658E+01	2.238E+01	2.218E+01	1.102E+01	1.614E+01	1.596E+01
900	3.494E+01	3.473E+01	1.597E+01	2.149E+01	2.147E+01	1.057E+01	1.551E+01	1.526E+01
1000	3.420E+01	3.401E+01	1.559E+01	2.087E+01	2.075E+01	1.019E+01	1.486E+01	1.472E+01
1250	3.307E+01	3.283E+01	1.494E+01	2.005E+01	1.998E+01	9.721E+00	1.416E+01	1.398E+01
1500	3.232E+01	3.223E+01	1.462E+01	1.970E+01	1.954E+01	9.532E+00	1.390E+01	1.373E+01
1750	3.207E+01	3.194E+01	1.441E+01	1.936E+01	1.931E+01	9.346E+00	1.382E+01	1.351E+01
2000	3.188E+01	3.177E+01	1.438E+01	1.939E+01	1.924E+01	9.341E+00	1.388E+01	1.352E+01
2250	3.190E+01	3.176E+01	1.434E+01	1.940E+01	1.932E+01	9.355E+00	1.372E+01	1.355E+01
2500	3.195E+01	3.177E+01	1.435E+01	1.945E+01	1.937E+01	9.365E+00	1.377E+01	1.363E+01
2750	3.207E+01	3.194E+01	1.439E+01	1.954E+01	1.939E+01	9.417E+00	1.388E+01	1.371E+01
3000	3.227E+01	3.206E+01	1.446E+01	1.965E+01	1.952E+01	9.449E+00	1.395E+01	1.377E+01

Table 37. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Fluorine from Secondary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	3.204E-01	2.117E-01	3.588E-03	6.783E-04	4.048E-04	1.552E-04	7.042E-05	1.319E-04
35	1.120E+00	5.980E-01	1.196E-02	3.298E-04	4.231E-04	4.354E-04	3.801E-04	6.610E-04
40	2.139E+00	1.360E+00	2.897E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	1.548E+00	2.117E+00	5.636E-02	4.176E-03	3.247E-03	1.513E-03	1.178E-03	1.217E-03
50	1.388E+00	2.308E+00	1.006E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
55	1.174E+00	1.811E+00	2.038E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	1.127E+00	1.634E+00	3.260E-01	1.282E-02	1.086E-02	5.846E-03	4.335E-03	3.604E-03
65	1.029E+00	1.435E+00	4.678E-01	1.707E-02	1.632E-02	7.980E-03	7.217E-03	6.182E-03
70	8.887E-01	1.303E+00	6.140E-01	2.585E-02	2.193E-02	1.160E-02	1.236E-02	1.169E-02
75	9.600E-01	1.204E+00	7.879E-01	3.970E-02	3.756E-02	1.581E-02	1.674E-02	1.534E-02
80	7.671E-01	1.046E+00	9.689E-01	7.044E-02	6.395E-02	2.336E-02	2.164E-02	2.080E-02
85	7.828E-01	9.981E-01	1.149E+00	1.101E-01	1.037E-01	3.469E-02	2.809E-02	2.484E-02
90	9.502E-01	1.093E+00	1.362E+00	1.712E-01	1.581E-01	5.062E-02	4.295E-02	3.809E-02
95	8.465E-01	1.038E+00	1.578E+00	2.672E-01	2.538E-01	7.673E-02	5.132E-02	4.742E-02
100	6.525E-01	1.014E+00	1.812E+00	3.714E-01	3.497E-01	1.142E-01	7.580E-02	7.097E-02
110	9.783E-01	1.008E+00	2.230E+00	7.569E-01	7.328E-01	2.358E-01	1.776E-01	1.702E-01
120	8.708E-01	9.360E-01	2.644E+00	1.231E+00	1.190E+00	4.209E-01	3.491E-01	3.386E-01
130	6.046E-01	8.640E-01	3.149E+00	1.605E+00	1.591E+00	6.577E-01	5.981E-01	5.781E-01
140	8.312E-01	8.849E-01	3.594E+00	1.959E+00	1.931E+00	8.714E-01	9.630E-01	9.396E-01
150	8.698E-01	8.559E-01	4.041E+00	2.328E+00	2.298E+00	1.061E+00	1.280E+00	1.259E+00
160	8.025E-01	9.704E-01	4.519E+00	2.932E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
170	8.328E-01	1.002E+00	4.949E+00	3.654E+00	3.559E+00	0.000E+00	0.000E+00	0.000E+00
180	7.054E-01	9.709E-01	5.353E+00	4.978E+00	4.777E+00	0.000E+00	0.000E+00	0.000E+00
190	6.763E-01	9.734E-01	5.623E+00	7.453E+00	6.988E+00	1.296E+00	0.000E+00	0.000E+00
200	8.444E-01	9.656E-01	5.641E+00	1.313E+01	1.199E+01	1.952E+00	0.000E+00	0.000E+00
300	8.813E-01	9.854E-01	2.810E+00	8.684E+00	9.143E+00	6.657E+00	1.402E+01	1.437E+01
400	8.360E-01	1.164E+00	2.503E+00	6.707E+00	7.377E+00	4.723E+00	9.269E+00	9.283E+00
500	1.254E+00	1.626E+00	2.354E+00	6.057E+00	6.816E+00	4.217E+00	8.173E+00	8.204E+00
600	1.580E+00	1.578E+00	2.222E+00	6.129E+00	8.740E+00	3.774E+00	8.406E+00	8.597E+00
700	1.355E+00	1.570E+00	2.136E+00	5.655E+00	8.196E+00	3.618E+00	8.497E+00	8.366E+00
800	1.451E+00	1.670E+00	2.078E+00	5.396E+00	7.828E+00	3.532E+00	7.821E+00	8.477E+00
900	1.432E+00	1.906E+00	2.041E+00	5.216E+00	8.149E+00	3.463E+00	9.047E+00	8.476E+00
1000	1.363E+00	1.655E+00	1.990E+00	5.365E+00	7.822E+00	3.434E+00	8.026E+00	8.288E+00
1250	1.436E+00	1.594E+00	1.909E+00	4.994E+00	7.597E+00	3.345E+00	7.281E+00	8.054E+00
1500	1.376E+00	1.559E+00	1.840E+00	4.727E+00	7.568E+00	3.273E+00	7.390E+00	7.990E+00
1750	1.361E+00	1.605E+00	1.834E+00	4.658E+00	7.471E+00	3.190E+00	7.189E+00	7.957E+00
2000	1.227E+00	1.542E+00	1.796E+00	4.649E+00	7.502E+00	3.191E+00	8.119E+00	7.841E+00
2250	1.335E+00	1.527E+00	1.790E+00	4.696E+00	7.429E+00	3.158E+00	8.237E+00	7.765E+00
2500	1.351E+00	1.639E+00	1.778E+00	4.600E+00	7.363E+00	3.132E+00	6.854E+00	7.807E+00
2750	1.278E+00	1.527E+00	1.773E+00	4.645E+00	7.402E+00	3.151E+00	7.657E+00	7.782E+00
3000	1.244E+00	1.647E+00	1.765E+00	4.774E+00	7.447E+00	3.152E+00	7.342E+00	8.003E+00

Table 38. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Neon from Primary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	1.218E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
35	5.414E+02	2.982E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
40	3.954E+02	4.706E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	3.257E+02	5.455E+02	1.255E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
50	2.815E+02	3.587E+02	6.984E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
55	2.510E+02	2.944E+02	1.038E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	2.276E+02	2.557E+02	1.318E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
65	2.094E+02	2.293E+02	1.567E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
70	1.947E+02	2.095E+02	1.797E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
75	1.825E+02	1.936E+02	2.014E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
80	1.718E+02	1.807E+02	2.216E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
85	1.626E+02	1.698E+02	2.412E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
90	1.549E+02	1.607E+02	2.604E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
95	1.480E+02	1.527E+02	2.786E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
100	1.416E+02	1.457E+02	2.961E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
110	1.313E+02	1.341E+02	3.297E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
120	1.224E+02	1.247E+02	3.615E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
130	1.151E+02	1.169E+02	3.908E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
140	1.090E+02	1.102E+02	4.186E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
150	1.037E+02	1.046E+02	4.471E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
160	9.895E+01	9.981E+01	4.709E+01	0.000E+00	3.032E-05	0.000E+00	0.000E+00	8.105E-07
170	9.482E+01	9.552E+01	4.956E+01	0.000E+00	9.173E-06	0.000E+00	0.000E+00	0.000E+00
180	9.131E+01	9.160E+01	5.157E+01	0.000E+00	2.669E-05	0.000E+00	0.000E+00	4.428E-06
190	8.800E+01	8.832E+01	5.352E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.492E-05
200	8.503E+01	8.535E+01	5.541E+01	0.000E+00	4.140E-04	0.000E+00	0.000E+00	0.000E+00
300	6.650E+01	6.644E+01	3.589E+01	5.924E+01	5.934E+01	3.994E+01	9.435E+01	1.028E+02
400	5.739E+01	5.709E+01	2.853E+01	4.164E+01	4.136E+01	2.217E+01	3.447E+01	3.414E+01
500	5.196E+01	5.180E+01	2.487E+01	3.475E+01	3.450E+01	1.783E+01	2.679E+01	2.642E+01
600	4.846E+01	4.826E+01	2.283E+01	3.137E+01	3.116E+01	1.576E+01	2.333E+01	2.299E+01
700	4.608E+01	4.589E+01	2.141E+01	2.913E+01	2.884E+01	1.442E+01	2.114E+01	2.092E+01
800	4.438E+01	4.415E+01	2.041E+01	2.745E+01	2.725E+01	1.357E+01	1.986E+01	1.958E+01
900	4.314E+01	4.292E+01	1.965E+01	2.632E+01	2.612E+01	1.287E+01	1.890E+01	1.856E+01
1000	4.226E+01	4.196E+01	1.913E+01	2.549E+01	2.527E+01	1.241E+01	1.803E+01	1.780E+01
1250	4.074E+01	4.046E+01	1.827E+01	2.431E+01	2.412E+01	1.176E+01	1.704E+01	1.677E+01
1500	3.985E+01	3.969E+01	1.790E+01	2.379E+01	2.358E+01	1.153E+01	1.683E+01	1.668E+01
1750	3.958E+01	3.945E+01	1.773E+01	2.368E+01	2.348E+01	1.140E+01	1.665E+01	1.651E+01
2000	3.942E+01	3.920E+01	1.764E+01	2.358E+01	2.335E+01	1.133E+01	1.663E+01	1.644E+01
2250	3.940E+01	3.920E+01	1.762E+01	2.366E+01	2.345E+01	1.137E+01	1.666E+01	1.640E+01
2500	3.939E+01	3.921E+01	1.762E+01	2.371E+01	2.354E+01	1.140E+01	1.676E+01	1.647E+01
2750	3.957E+01	3.940E+01	1.767E+01	2.380E+01	2.363E+01	1.137E+01	1.672E+01	1.650E+01
3000	3.976E+01	3.950E+01	1.772E+01	2.391E+01	2.370E+01	1.146E+01	1.697E+01	1.665E+01

Table 39. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Neon from Secondary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	3.312E-01	2.104E-01	4.163E-03	5.894E-04	2.365E-04	2.219E-04	0.000E+00	0.000E+00
35	8.756E-01	5.281E-01	1.221E-02	6.129E-04	5.413E-04	4.233E-04	9.578E-05	1.825E-04
40	2.313E+00	1.118E+00	2.785E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	1.931E+00	1.983E+00	5.190E-02	2.391E-03	2.544E-03	1.426E-03	9.615E-04	7.558E-04
50	1.605E+00	2.636E+00	8.559E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
55	1.398E+00	2.443E+00	1.564E-01	7.728E-03	5.972E-03	3.425E-03	3.147E-03	2.431E-03
60	1.404E+00	1.995E+00	2.803E-01	1.020E-02	1.008E-02	5.036E-03	3.927E-03	4.283E-03
65	1.187E+00	1.702E+00	4.039E-01	1.349E-02	1.161E-02	6.548E-03	5.821E-03	5.087E-03
70	1.025E+00	1.498E+00	5.398E-01	2.213E-02	1.816E-02	8.270E-03	1.011E-02	9.072E-03
75	9.907E-01	1.460E+00	6.996E-01	3.080E-02	2.881E-02	1.225E-02	1.127E-02	1.069E-02
80	9.369E-01	1.318E+00	8.826E-01	6.358E-02	5.923E-02	1.898E-02	1.666E-02	1.564E-02
85	8.717E-01	1.346E+00	1.071E+00	1.054E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
90	7.225E-01	1.182E+00	1.267E+00	1.638E-01	1.526E-01	4.414E-02	3.235E-02	2.983E-02
95	8.186E-01	1.125E+00	1.451E+00	2.426E-01	2.343E-01	5.828E-02	0.000E+00	0.000E+00
100	7.718E-01	1.034E+00	1.667E+00	3.589E-01	3.358E-01	8.593E-02	0.000E+00	0.000E+00
110	9.009E-01	1.092E+00	2.141E+00	7.091E-01	6.729E-01	2.217E-01	1.685E-01	1.596E-01
120	9.725E-01	1.034E+00	2.564E+00	1.084E+00	1.055E+00	3.780E-01	3.361E-01	3.166E-01
130	7.763E-01	1.028E+00	3.023E+00	1.497E+00	1.455E+00	6.009E-01	5.648E-01	5.470E-01
140	7.959E-01	9.945E-01	2.977E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
150	7.104E-01	9.538E-01	3.837E+00	2.141E+00	2.111E+00	9.795E-01	1.163E+00	1.143E+00
160	1.098E+00	1.150E+00	4.353E+00	2.628E+00	2.544E+00	1.181E+00	1.473E+00	1.459E+00
170	8.630E-01	9.940E-01	4.812E+00	3.134E+00	3.004E+00	1.360E+00	1.728E+00	1.709E+00
180	8.774E-01	1.100E+00	5.230E+00	3.923E+00	3.810E+00	1.637E+00	2.056E+00	2.025E+00
190	1.066E+00	1.155E+00	5.651E+00	5.290E+00	5.055E+00	1.963E+00	2.358E+00	2.303E+00
200	9.200E-01	1.008E+00	5.969E+00	7.217E+00	6.820E+00	2.408E+00	2.655E+00	2.655E+00
300	1.034E+00	1.296E+00	3.463E+00	1.074E+01	1.134E+01	9.191E+00	2.218E+01	2.277E+01
400	1.020E+00	1.331E+00	2.958E+00	8.085E+00	8.895E+00	5.691E+00	1.097E+01	1.118E+01
500	1.251E+00	1.616E+00	2.738E+00	7.143E+00	8.105E+00	4.977E+00	9.203E+00	9.641E+00
600	1.407E+00	1.560E+00	2.553E+00	6.559E+00	9.063E+00	4.527E+00	8.777E+00	8.844E+00
700	1.420E+00	1.704E+00	2.413E+00	6.535E+00	9.894E+00	4.118E+00	1.003E+01	9.579E+00
800	1.459E+00	1.721E+00	2.353E+00	6.581E+00	8.930E+00	4.013E+00	8.919E+00	9.256E+00
900	1.500E+00	1.767E+00	2.360E+00	6.113E+00	8.857E+00	4.011E+00	8.711E+00	9.477E+00
1000	1.629E+00	1.621E+00	2.259E+00	6.045E+00	8.888E+00	3.948E+00	8.671E+00	9.335E+00
1250	1.607E+00	1.820E+00	2.210E+00	5.771E+00	8.632E+00	3.880E+00	9.123E+00	9.110E+00
1500	1.387E+00	1.797E+00	2.116E+00	5.585E+00	8.675E+00	3.722E+00	7.816E+00	8.837E+00
1750	1.175E+00	1.707E+00	2.065E+00	5.459E+00	8.540E+00	3.646E+00	8.487E+00	8.713E+00
2000	1.466E+00	1.724E+00	2.028E+00	5.381E+00	8.386E+00	3.628E+00	8.495E+00	9.016E+00
2250	1.454E+00	1.587E+00	1.989E+00	5.295E+00	7.763E+00	3.594E+00	8.875E+00	8.936E+00
2500	1.374E+00	1.628E+00	2.023E+00	5.474E+00	8.043E+00	3.604E+00	8.327E+00	9.067E+00
2750	1.484E+00	1.531E+00	1.996E+00	5.343E+00	8.221E+00	3.613E+00	8.482E+00	8.799E+00
3000	1.473E+00	1.659E+00	2.022E+00	5.410E+00	7.582E+00	3.595E+00	8.079E+00	8.598E+00

Table 40. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Sodium from Primary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	1.060E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
35	7.034E+02	3.046E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
40	4.958E+02	5.151E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	4.017E+02	6.840E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
50	3.459E+02	4.579E+02	6.884E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
55	3.067E+02	3.666E+02	1.116E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	2.779E+02	3.164E+02	1.453E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
65	2.556E+02	2.824E+02	1.749E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
70	2.372E+02	2.567E+02	2.018E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
75	2.215E+02	2.368E+02	2.274E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
80	2.089E+02	2.208E+02	2.516E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
85	1.976E+02	2.073E+02	2.738E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
90	1.882E+02	1.958E+02	2.966E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
95	1.794E+02	1.857E+02	3.171E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
100	1.719E+02	1.774E+02	3.383E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
110	1.592E+02	1.628E+02	3.772E+01	0.000E+00	1.380E-05	0.000E+00	0.000E+00	0.000E+00
120	1.484E+02	1.516E+02	4.140E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
130	1.399E+02	1.419E+02	4.492E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
140	1.322E+02	1.338E+02	4.821E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
150	1.257E+02	1.269E+02	5.131E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
160	1.199E+02	1.209E+02	5.412E+01	2.433E-03	2.555E-03	2.422E-06	0.000E+00	1.579E-03
170	1.149E+02	1.156E+02	5.701E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
180	1.106E+02	1.111E+02	5.966E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
190	1.065E+02	1.069E+02	6.186E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
200	1.031E+02	1.033E+02	6.408E+01	0.000E+00	2.846E-04	0.000E+00	0.000E+00	0.000E+00
300	8.058E+01	8.051E+01	4.378E+01	7.343E+01	7.377E+01	6.121E+01	5.116E+02	9.113E+00
400	6.955E+01	6.914E+01	3.456E+01	5.058E+01	5.035E+01	2.725E+01	4.285E+01	4.247E+01
500	6.290E+01	6.266E+01	3.010E+01	4.212E+01	4.180E+01	2.158E+01	3.246E+01	3.212E+01
600	5.867E+01	5.843E+01	2.746E+01	3.758E+01	3.729E+01	1.893E+01	2.801E+01	2.770E+01
700	5.576E+01	5.546E+01	2.571E+01	3.473E+01	3.455E+01	1.728E+01	2.536E+01	2.504E+01
800	5.366E+01	5.345E+01	2.454E+01	3.279E+01	3.266E+01	1.616E+01	2.358E+01	2.332E+01
900	5.209E+01	5.194E+01	2.365E+01	3.147E+01	3.130E+01	1.547E+01	2.275E+01	2.234E+01
1000	5.114E+01	5.078E+01	2.302E+01	3.046E+01	3.028E+01	1.479E+01	2.195E+01	2.123E+01
1250	4.930E+01	4.898E+01	2.201E+01	2.904E+01	2.884E+01	1.409E+01	2.048E+01	2.031E+01
1500	4.835E+01	4.804E+01	2.155E+01	2.849E+01	2.846E+01	1.377E+01	2.016E+01	1.985E+01
1750	4.793E+01	4.773E+01	2.131E+01	2.819E+01	2.803E+01	1.354E+01	1.967E+01	1.935E+01
2000	4.774E+01	4.746E+01	2.124E+01	2.824E+01	2.807E+01	1.365E+01	2.009E+01	1.970E+01
2250	4.779E+01	4.744E+01	2.119E+01	2.828E+01	2.818E+01	1.359E+01	2.027E+01	1.977E+01
2500	4.778E+01	4.749E+01	2.123E+01	2.831E+01	2.821E+01	1.363E+01	1.992E+01	1.980E+01
2750	4.779E+01	4.765E+01	2.131E+01	2.855E+01	2.830E+01	1.364E+01	2.001E+01	1.978E+01
3000	4.820E+01	4.799E+01	2.137E+01	2.864E+01	2.840E+01	1.372E+01	2.011E+01	1.991E+01

Table 41. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Sodium from Secondary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	4.231E-01	2.325E-01	5.441E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
35	1.017E+00	5.468E-01	1.449E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
40	2.693E+00	1.322E+00	3.096E-02	2.828E-03	2.262E-03	1.031E-03	5.069E-04	5.575E-04
45	2.488E+00	2.495E+00	5.852E-02	4.206E-03	3.013E-03	0.000E+00	0.000E+00	0.000E+00
50	1.993E+00	3.273E+00	9.639E-02	5.131E-03	4.658E-03	0.000E+00	0.000E+00	0.000E+00
55	1.705E+00	3.115E+00	1.603E-01	8.605E-03	7.260E-03	3.809E-03	2.846E-03	2.912E-03
60	1.615E+00	2.537E+00	2.919E-01	1.145E-02	9.679E-03	5.811E-03	6.302E-03	6.410E-03
65	1.420E+00	2.114E+00	4.360E-01	1.529E-02	1.373E-02	7.663E-03	7.439E-03	6.697E-03
70	1.287E+00	1.911E+00	5.956E-01	2.464E-02	2.332E-02	1.037E-02	9.371E-03	9.958E-03
75	1.109E+00	1.795E+00	7.751E-01	4.051E-02	3.594E-02	1.553E-02	1.369E-02	1.204E-02
80	1.150E+00	1.698E+00	9.728E-01	6.923E-02	6.086E-02	2.191E-02	1.972E-02	1.897E-02
85	1.093E+00	1.537E+00	1.193E+00	1.179E-01	1.106E-01	3.538E-02	2.736E-02	2.505E-02
90	9.768E-01	1.389E+00	1.404E+00	1.726E-01	1.652E-01	5.135E-02	3.528E-02	3.572E-02
95	9.147E-01	1.467E+00	1.666E+00	2.510E-01	2.402E-01	6.261E-02	0.000E+00	0.000E+00
100	1.095E+00	1.391E+00	1.890E+00	3.645E-01	3.454E-01	1.143E-01	8.036E-02	7.250E-02
110	9.054E-01	1.162E+00	2.396E+00	7.116E-01	6.805E-01	2.322E-01	1.917E-01	1.762E-01
120	7.750E-01	1.034E+00	2.933E+00	1.121E+00	1.096E+00	3.988E-01	3.563E-01	3.420E-01
130	8.601E-01	1.020E+00	3.422E+00	1.456E+00	1.442E+00	5.910E-01	5.506E-01	5.297E-01
140	9.213E-01	1.178E+00	4.038E+00	1.806E+00	1.781E+00	8.078E-01	9.292E-01	8.668E-01
150	9.541E-01	1.218E+00	4.568E+00	2.147E+00	2.124E+00	1.001E+00	1.229E+00	1.203E+00
160	1.010E+00	1.197E+00	5.188E+00	2.506E+00	2.494E+00	1.195E+00	1.506E+00	1.497E+00
170	9.899E-01	1.147E+00	5.031E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
180	9.594E-01	1.159E+00	6.307E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
190	9.088E-01	1.158E+00	7.036E+00	4.472E+00	5.764E-01	0.000E+00	0.000E+00	0.000E+00
200	9.082E-01	1.241E+00	7.570E+00	6.013E+00	5.635E+00	0.000E+00	0.000E+00	0.000E+00
300	1.052E+00	1.226E+00	4.726E+00	1.518E+01	1.586E+01	1.461E+01	3.657E+01	3.173E+01
400	1.229E+00	1.361E+00	3.861E+00	1.089E+01	1.180E+01	7.805E+00	1.522E+01	1.546E+01
500	1.066E+00	1.381E+00	3.463E+00	9.455E+00	1.052E+01	6.645E+00	1.266E+01	1.269E+01
600	1.408E+00	1.654E+00	3.302E+00	8.768E+00	9.842E+00	6.003E+00	1.192E+01	1.155E+01
700	1.360E+00	1.572E+00	3.150E+00	8.343E+00	1.117E+01	5.545E+00	1.118E+01	1.083E+01
800	1.390E+00	1.529E+00	2.984E+00	8.357E+00	1.031E+01	5.227E+00	1.091E+01	1.150E+01
900	1.498E+00	1.586E+00	2.907E+00	7.988E+00	1.014E+01	5.112E+00	1.154E+01	1.142E+01
1000	1.521E+00	1.647E+00	2.860E+00	7.890E+00	1.048E+01	5.098E+00	1.071E+01	1.125E+01
1250	1.323E+00	1.861E+00	2.774E+00	7.582E+00	9.887E+00	4.939E+00	1.085E+01	1.150E+01
1500	1.328E+00	1.615E+00	2.671E+00	7.167E+00	9.757E+00	4.798E+00	1.072E+01	1.053E+01
1750	1.476E+00	1.583E+00	2.622E+00	7.179E+00	9.772E+00	4.798E+00	1.127E+01	1.066E+01
2000	1.232E+00	1.618E+00	2.600E+00	7.167E+00	9.689E+00	4.707E+00	1.076E+01	1.094E+01
2250	1.349E+00	1.514E+00	2.566E+00	7.031E+00	9.231E+00	4.665E+00	9.527E+00	1.036E+01
2500	1.304E+00	1.436E+00	2.560E+00	7.046E+00	9.514E+00	4.657E+00	1.222E+01	1.081E+01
2750	1.157E+00	1.436E+00	2.551E+00	7.060E+00	9.713E+00	4.691E+00	1.095E+01	1.100E+01
3000	1.281E+00	1.552E+00	2.558E+00	7.003E+00	9.543E+00	4.702E+00	1.059E+01	1.070E+01

Table 42. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Magnesium from Primary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
35	1.119E+03	1.723E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
40	6.578E+02	4.533E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	5.109E+02	6.504E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
50	4.306E+02	7.024E+02	2.127E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
55	3.780E+02	4.844E+02	8.902E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	3.394E+02	4.021E+02	1.310E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
65	3.101E+02	3.522E+02	1.653E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
70	2.867E+02	3.170E+02	1.961E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
75	2.678E+02	2.905E+02	2.242E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
80	2.515E+02	2.692E+02	2.511E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
85	2.378E+02	2.515E+02	2.758E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
90	2.260E+02	2.373E+02	3.000E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
95	2.157E+02	2.247E+02	3.230E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
100	2.061E+02	2.137E+02	3.461E+01	0.000E+00	2.358E-05	0.000E+00	0.000E+00	0.000E+00
110	1.904E+02	1.958E+02	3.889E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.099E-04
120	1.776E+02	1.817E+02	4.302E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
130	1.670E+02	1.698E+02	4.673E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
140	1.577E+02	1.601E+02	5.030E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
150	1.499E+02	1.518E+02	5.360E+01	3.650E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
160	1.431E+02	1.446E+02	5.688E+01	0.000E+00	8.243E-06	0.000E+00	0.000E+00	9.726E-06
170	1.372E+02	1.381E+02	6.013E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
180	1.316E+02	1.329E+02	6.287E+01	0.000E+00	3.420E-06	0.000E+00	0.000E+00	5.632E-05
190	1.272E+02	1.278E+02	6.565E+01	3.847E-04	2.858E-03	0.000E+00	0.000E+00	6.877E-05
200	1.226E+02	1.232E+02	6.817E+01	0.000E+00	5.314E-05	0.000E+00	0.000E+00	0.000E+00
300	9.582E+01	9.587E+01	5.395E+01	9.818E+01	9.926E+01	5.825E+01	0.000E+00	1.325E-02
400	8.269E+01	8.242E+01	4.147E+01	6.166E+01	6.136E+01	3.409E+01	5.509E+01	5.492E+01
500	7.492E+01	7.447E+01	3.596E+01	5.055E+01	5.027E+01	2.619E+01	3.966E+01	3.923E+01
600	6.968E+01	6.943E+01	3.275E+01	4.487E+01	4.452E+01	2.276E+01	3.369E+01	3.335E+01
700	6.627E+01	6.603E+01	3.067E+01	4.134E+01	4.101E+01	2.066E+01	3.045E+01	3.004E+01
800	6.373E+01	6.343E+01	2.919E+01	3.898E+01	3.868E+01	1.924E+01	2.834E+01	2.793E+01
900	6.201E+01	6.185E+01	2.813E+01	3.724E+01	3.690E+01	1.834E+01	2.684E+01	2.646E+01
1000	6.076E+01	6.037E+01	2.735E+01	3.608E+01	3.583E+01	1.761E+01	2.567E+01	2.541E+01
1250	5.863E+01	5.828E+01	2.617E+01	3.452E+01	3.429E+01	1.677E+01	2.434E+01	2.412E+01
1500	5.741E+01	5.709E+01	2.557E+01	3.373E+01	3.350E+01	1.626E+01	2.367E+01	2.340E+01
1750	5.693E+01	5.670E+01	2.524E+01	3.319E+01	3.294E+01	1.602E+01	2.375E+01	2.297E+01
2000	5.664E+01	5.639E+01	2.523E+01	3.342E+01	3.315E+01	1.611E+01	2.352E+01	2.324E+01
2250	5.685E+01	5.640E+01	2.514E+01	3.328E+01	3.305E+01	1.607E+01	2.353E+01	2.321E+01
2500	5.670E+01	5.644E+01	2.519E+01	3.344E+01	3.332E+01	1.608E+01	2.350E+01	2.318E+01
2750	5.695E+01	5.659E+01	2.512E+01	3.332E+01	3.302E+01	1.608E+01	2.361E+01	2.337E+01
3000	5.731E+01	5.698E+01	2.530E+01	3.369E+01	3.344E+01	1.617E+01	2.376E+01	2.352E+01

Table 43. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Magnesium from Secondary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	3.492E-01	1.905E-01	4.284E-03	1.715E-04	1.656E-05	1.849E-04	0.000E+00	0.000E+00
35	8.545E-01	5.089E-01	1.324E-02	1.000E-03	7.337E-04	5.296E-04	0.000E+00	0.000E+00
40	2.632E+00	1.151E+00	2.977E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	2.840E+00	2.255E+00	5.273E-02	3.286E-03	2.638E-03	1.408E-03	0.000E+00	0.000E+00
50	2.227E+00	3.194E+00	8.955E-02	5.817E-03	4.257E-03	2.147E-03	0.000E+00	0.000E+00
55	1.909E+00	3.729E+00	1.373E-01	7.490E-03	6.051E-03	0.000E+00	0.000E+00	0.000E+00
60	1.771E+00	3.063E+00	2.448E-01	1.104E-02	9.096E-03	4.753E-03	4.443E-03	4.492E-03
65	1.641E+00	2.545E+00	3.826E-01	1.686E-02	1.348E-02	6.745E-03	6.449E-03	6.562E-03
70	1.406E+00	2.170E+00	5.491E-01	1.737E-02	1.844E-02	8.892E-03	8.374E-03	7.936E-03
75	1.278E+00	1.975E+00	7.099E-01	2.876E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00
80	1.129E+00	1.841E+00	8.836E-01	5.428E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00
85	1.130E+00	1.671E+00	1.097E+00	1.069E-01	9.900E-02	2.759E-02	0.000E+00	0.000E+00
90	1.172E+00	1.698E+00	1.348E+00	1.623E-01	1.529E-01	4.604E-02	3.321E-02	3.038E-02
95	1.088E+00	1.561E+00	1.565E+00	2.263E-01	2.117E-01	7.020E-02	0.000E+00	0.000E+00
100	1.023E+00	1.428E+00	1.751E+00	3.285E-01	3.087E-01	1.012E-01	6.567E-02	6.240E-02
110	9.958E-01	1.344E+00	2.283E+00	7.037E-01	6.289E-01	2.076E-01	1.640E-01	1.589E-01
120	9.239E-01	1.215E+00	2.757E+00	1.045E+00	1.015E+00	3.689E-01	3.031E-01	2.987E-01
130	9.582E-01	1.276E+00	3.334E+00	1.445E+00	1.406E+00	5.842E-01	5.615E-01	5.275E-01
140	8.926E-01	1.134E+00	3.882E+00	1.783E+00	1.778E+00	8.041E-01	8.823E-01	8.556E-01
150	9.776E-01	1.241E+00	4.459E+00	2.100E+00	2.098E+00	9.988E-01	1.222E+00	1.200E+00
160	1.011E+00	1.252E+00	5.038E+00	2.404E+00	2.401E+00	1.159E+00	1.476E+00	1.468E+00
170	1.050E+00	1.292E+00	4.825E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
180	9.108E-01	1.176E+00	6.276E+00	3.197E+00	3.166E+00	1.515E+00	2.037E+00	1.987E+00
190	1.145E+00	1.296E+00	6.873E+00	3.861E+00	3.755E+00	1.705E+00	2.263E+00	2.227E+00
200	1.231E+00	1.305E+00	7.462E+00	4.870E+00	4.681E+00	1.962E+00	2.485E+00	2.494E+00
300	1.168E+00	1.469E+00	5.542E+00	1.882E+01	1.949E+01	1.644E+01	1.721E+01	1.639E+01
400	1.115E+00	1.397E+00	4.344E+00	1.261E+01	1.363E+01	9.152E+00	1.811E+01	1.837E+01
500	1.313E+00	1.366E+00	3.912E+00	1.087E+01	1.191E+01	7.650E+00	1.436E+01	1.488E+01
600	1.317E+00	1.498E+00	3.673E+00	9.936E+00	1.114E+01	6.891E+00	1.285E+01	1.344E+01
700	1.277E+00	1.510E+00	3.513E+00	9.478E+00	1.082E+01	6.368E+00	1.219E+01	1.258E+01
800	1.277E+00	1.699E+00	3.325E+00	9.161E+00	1.189E+01	5.877E+00	1.258E+01	1.260E+01
900	1.344E+00	1.754E+00	3.252E+00	8.918E+00	1.183E+01	5.673E+00	1.180E+01	1.229E+01
1000	1.517E+00	1.669E+00	3.173E+00	8.798E+00	1.113E+01	5.646E+00	1.125E+01	1.227E+01
1250	1.379E+00	1.558E+00	3.053E+00	8.295E+00	1.137E+01	5.501E+00	1.137E+01	1.207E+01
1500	1.360E+00	1.674E+00	2.953E+00	7.994E+00	1.096E+01	5.386E+00	1.205E+01	1.209E+01
1750	1.381E+00	1.696E+00	2.947E+00	7.980E+00	1.070E+01	5.353E+00	1.180E+01	1.213E+01
2000	1.513E+00	1.809E+00	2.843E+00	7.802E+00	1.075E+01	5.192E+00	1.176E+01	1.178E+01
2250	1.385E+00	1.583E+00	2.829E+00	7.772E+00	1.032E+01	5.146E+00	1.082E+01	1.196E+01
2500	1.330E+00	1.831E+00	2.824E+00	7.827E+00	1.082E+01	5.192E+00	1.141E+01	1.189E+01
2750	1.452E+00	1.645E+00	2.867E+00	7.923E+00	1.031E+01	5.166E+00	1.075E+01	1.189E+01
3000	1.363E+00	1.584E+00	2.820E+00	7.875E+00	1.055E+01	5.174E+00	1.082E+01	1.152E+01

Table 44. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Aluminum from Primary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
35	1.573E+03	1.077E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
40	8.095E+02	4.732E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	6.150E+02	7.036E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
50	5.142E+02	8.989E+02	1.054E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
55	4.484E+02	5.956E+02	8.748E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	4.023E+02	4.844E+02	1.385E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
65	3.671E+02	4.209E+02	1.786E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
70	3.392E+02	3.774E+02	2.143E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
75	3.161E+02	3.447E+02	2.471E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
80	2.966E+02	3.190E+02	2.775E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
85	2.800E+02	2.975E+02	3.059E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
90	2.662E+02	2.799E+02	3.334E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.311E-05
95	2.542E+02	2.655E+02	3.599E+01	0.000E+00	1.601E-06	0.000E+00	0.000E+00	0.000E+00
100	2.429E+02	2.521E+02	3.858E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
110	2.244E+02	2.310E+02	4.332E+01	0.000E+00	9.182E-04	0.000E+00	0.000E+00	0.000E+00
120	2.090E+02	2.138E+02	4.792E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.363E-03
130	1.961E+02	1.999E+02	5.230E+01	0.000E+00	1.929E-05	0.000E+00	0.000E+00	0.000E+00
140	1.854E+02	1.884E+02	5.638E+01	0.000E+00	2.916E-03	0.000E+00	0.000E+00	8.580E-06
150	1.761E+02	1.785E+02	6.020E+01	0.000E+00	1.294E-02	0.000E+00	0.000E+00	0.000E+00
160	1.682E+02	1.699E+02	6.389E+01	0.000E+00	3.148E-03	0.000E+00	0.000E+00	1.173E-02
170	1.609E+02	1.626E+02	6.716E+01	1.600E-02	1.904E-05	0.000E+00	0.000E+00	1.241E-02
180	1.548E+02	1.559E+02	7.060E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
190	1.492E+02	1.499E+02	7.372E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
200	1.441E+02	1.448E+02	7.678E+01	1.941E-04	5.943E-03	0.000E+00	1.931E-02	1.287E-03
300	1.124E+02	1.125E+02	6.356E+01	1.189E+02	1.209E+02	5.910E+01	0.000E+00	4.337E-03
400	9.720E+01	9.663E+01	4.840E+01	7.169E+01	7.141E+01	3.993E+01	6.534E+01	6.534E+01
500	8.793E+01	8.749E+01	4.175E+01	5.819E+01	5.783E+01	3.011E+01	4.569E+01	4.523E+01
600	8.180E+01	8.148E+01	3.800E+01	5.151E+01	5.120E+01	2.598E+01	3.840E+01	3.801E+01
700	7.793E+01	7.745E+01	3.557E+01	4.734E+01	4.702E+01	2.346E+01	3.439E+01	3.395E+01
800	7.491E+01	7.456E+01	3.391E+01	4.472E+01	4.432E+01	2.200E+01	3.200E+01	3.158E+01
900	7.286E+01	7.252E+01	3.261E+01	4.256E+01	4.235E+01	2.077E+01	3.010E+01	2.969E+01
1000	7.130E+01	7.086E+01	3.158E+01	4.097E+01	4.087E+01	1.993E+01	2.871E+01	2.854E+01
1250	6.879E+01	6.848E+01	3.028E+01	3.919E+01	3.919E+01	1.892E+01	2.739E+01	2.720E+01
1500	6.744E+01	6.705E+01	2.962E+01	3.822E+01	3.827E+01	1.837E+01	2.704E+01	2.644E+01
1750	6.692E+01	6.646E+01	2.937E+01	3.830E+01	3.819E+01	1.838E+01	2.657E+01	2.637E+01
2000	6.652E+01	6.630E+01	2.911E+01	3.777E+01	3.757E+01	1.806E+01	2.618E+01	2.590E+01
2250	6.661E+01	6.611E+01	2.905E+01	3.784E+01	3.775E+01	1.814E+01	2.642E+01	2.615E+01
2500	6.664E+01	6.633E+01	2.918E+01	3.823E+01	3.797E+01	1.829E+01	2.662E+01	2.640E+01
2750	6.694E+01	6.648E+01	2.917E+01	3.812E+01	3.787E+01	1.818E+01	2.666E+01	2.622E+01
3000	6.720E+01	6.693E+01	2.923E+01	3.822E+01	3.803E+01	1.823E+01	2.718E+01	2.643E+01

Table 45. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Aluminum from Secondary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	3.343E-01	1.778E-01	4.816E-03	4.132E-04	3.364E-04	1.821E-04	1.385E-04	1.597E-04
35	1.053E+00	5.505E-01	1.444E-02	1.173E-03	6.895E-04	4.643E-04	5.309E-04	6.968E-04
40	3.032E+00	1.130E+00	3.154E-02	2.547E-03	1.618E-03	9.837E-04	6.344E-04	7.812E-04
45	3.985E+00	2.561E+00	5.553E-02	3.247E-03	3.080E-03	1.478E-03	1.227E-03	5.792E-04
50	3.146E+00	3.909E+00	9.686E-02	6.411E-03	5.256E-03	0.000E+00	0.000E+00	0.000E+00
55	2.616E+00	4.810E+00	1.459E-01	1.012E-02	8.072E-03	3.678E-03	0.000E+00	0.000E+00
60	2.154E+00	4.089E+00	2.420E-01	1.356E-02	1.285E-02	5.474E-03	4.278E-03	3.545E-03
65	1.903E+00	3.380E+00	4.070E-01	1.816E-02	1.635E-02	7.335E-03	8.115E-03	6.728E-03
70	1.628E+00	2.762E+00	5.678E-01	2.494E-02	2.258E-02	1.066E-02	9.040E-03	9.463E-03
75	1.582E+00	2.525E+00	7.631E-01	4.191E-02	3.873E-02	1.634E-02	1.489E-02	1.320E-02
80	1.546E+00	2.302E+00	9.646E-01	7.640E-02	6.887E-02	2.316E-02	1.940E-02	1.924E-02
85	1.384E+00	2.082E+00	1.218E+00	1.379E-01	1.280E-01	3.817E-02	2.754E-02	2.783E-02
90	1.378E+00	1.986E+00	1.465E+00	1.849E-01	1.836E-01	5.735E-02	4.267E-02	3.638E-02
95	1.231E+00	1.830E+00	1.712E+00	2.496E-01	2.395E-01	8.366E-02	5.383E-02	0.000E+00
100	1.434E+00	1.856E+00	1.968E+00	3.456E-01	3.262E-01	8.781E-02	0.000E+00	0.000E+00
110	1.151E+00	1.688E+00	2.603E+00	6.956E-01	6.679E-01	2.229E-01	1.831E-01	1.833E-01
120	1.114E+00	1.434E+00	3.175E+00	1.148E+00	1.113E+00	3.990E-01	3.439E-01	3.405E-01
130	1.078E+00	1.332E+00	3.782E+00	1.484E+00	1.445E+00	6.047E-01	5.677E-01	5.494E-01
140	1.043E+00	1.271E+00	4.432E+00	1.852E+00	1.824E+00	8.421E-01	9.239E-01	9.051E-01
150	1.069E+00	1.495E+00	5.154E+00	2.132E+00	2.100E+00	1.023E+00	1.284E+00	1.217E+00
160	9.493E-01	1.307E+00	5.845E+00	2.433E+00	2.414E+00	1.197E+00	1.553E+00	1.538E+00
170	9.364E-01	1.322E+00	6.636E+00	2.825E+00	2.807E+00	1.395E+00	1.864E+00	1.855E+00
180	1.113E+00	1.467E+00	6.443E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
190	1.212E+00	1.432E+00	8.213E+00	3.651E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
200	1.211E+00	1.593E+00	8.895E+00	4.310E+00	4.205E+00	1.914E+00	2.589E+00	2.568E+00
300	1.273E+00	1.526E+00	7.443E+00	2.647E+01	2.733E+01	2.045E+01	1.399E+01	1.330E+01
400	1.101E+00	1.408E+00	5.780E+00	1.704E+01	1.819E+01	1.244E+01	2.483E+01	2.535E+01
500	1.202E+00	1.504E+00	5.124E+00	1.434E+01	1.555E+01	1.008E+01	1.904E+01	1.957E+01
600	1.199E+00	1.502E+00	4.750E+00	1.307E+01	1.435E+01	8.998E+00	1.707E+01	1.752E+01
700	1.167E+00	1.540E+00	4.540E+00	1.251E+01	1.394E+01	8.482E+00	1.606E+01	1.670E+01
800	1.380E+00	1.624E+00	4.314E+00	1.177E+01	1.315E+01	7.825E+00	1.553E+01	1.566E+01
900	1.581E+00	1.694E+00	4.167E+00	1.162E+01	1.364E+01	7.411E+00	1.498E+01	1.528E+01
1000	1.345E+00	1.629E+00	4.140E+00	1.144E+01	1.386E+01	7.289E+00	1.528E+01	1.486E+01
1250	1.309E+00	1.605E+00	3.952E+00	1.086E+01	1.378E+01	7.125E+00	1.471E+01	1.488E+01
1500	1.251E+00	1.585E+00	3.806E+00	1.047E+01	1.292E+01	6.932E+00	1.432E+01	1.492E+01
1750	1.354E+00	1.595E+00	3.695E+00	1.043E+01	1.306E+01	6.814E+00	1.345E+01	1.487E+01
2000	1.302E+00	1.607E+00	3.662E+00	1.025E+01	1.214E+01	6.722E+00	1.362E+01	1.479E+01
2250	1.304E+00	1.599E+00	3.682E+00	1.014E+01	1.278E+01	6.700E+00	1.537E+01	1.425E+01
2500	1.338E+00	1.663E+00	3.613E+00	9.947E+00	1.205E+01	6.614E+00	1.390E+01	1.385E+01
2750	1.574E+00	1.561E+00	3.657E+00	1.022E+01	1.275E+01	6.704E+00	1.424E+01	1.464E+01
3000	1.282E+00	1.518E+00	3.614E+00	1.015E+01	1.276E+01	6.655E+00	1.413E+01	1.411E+01

Table 46. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Silicon from Primary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
35	1.408E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
40	1.107E+03	3.663E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	7.737E+02	6.456E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
50	6.283E+02	8.657E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
55	5.413E+02	8.409E+02	3.987E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	4.806E+02	6.138E+02	1.136E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
65	4.353E+02	5.177E+02	1.624E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
70	4.007E+02	4.569E+02	2.029E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
75	3.725E+02	4.132E+02	2.393E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
80	3.484E+02	3.803E+02	2.731E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
85	3.292E+02	3.533E+02	3.048E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
90	3.117E+02	3.310E+02	3.342E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
95	2.969E+02	3.133E+02	3.632E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
100	2.835E+02	2.973E+02	3.910E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
110	2.614E+02	2.713E+02	4.434E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
120	2.433E+02	2.508E+02	4.927E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
130	2.283E+02	2.337E+02	5.389E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
140	2.160E+02	2.198E+02	5.833E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
150	2.048E+02	2.077E+02	6.247E+01	0.000E+00	7.355E-06	0.000E+00	0.000E+00	0.000E+00
160	1.955E+02	1.978E+02	6.657E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.759E-06
170	1.870E+02	1.889E+02	7.027E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
180	1.798E+02	1.816E+02	7.401E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
190	1.732E+02	1.746E+02	7.742E+01	0.000E+00	5.859E-06	0.000E+00	0.000E+00	6.864E-06
200	1.676E+02	1.686E+02	8.057E+01	0.000E+00	3.159E-04	0.000E+00	0.000E+00	0.000E+00
300	1.306E+02	1.306E+02	7.775E+01	1.738E+02	1.821E+02	4.259E+01	0.000E+00	7.117E-05
400	1.125E+02	1.121E+02	5.705E+01	8.668E+01	8.645E+01	5.070E+01	8.909E+01	8.984E+01
500	1.020E+02	1.015E+02	4.896E+01	6.922E+01	6.862E+01	3.639E+01	5.588E+01	5.543E+01
600	9.492E+01	9.455E+01	4.441E+01	6.054E+01	6.008E+01	3.083E+01	4.594E+01	4.543E+01
700	9.032E+01	8.981E+01	4.137E+01	5.538E+01	5.494E+01	2.767E+01	4.072E+01	4.023E+01
800	8.687E+01	8.638E+01	3.933E+01	5.203E+01	5.146E+01	2.564E+01	3.743E+01	3.694E+01
900	8.455E+01	8.418E+01	3.781E+01	4.943E+01	4.897E+01	2.422E+01	3.512E+01	3.468E+01
1000	8.260E+01	8.216E+01	3.683E+01	4.819E+01	4.776E+01	2.336E+01	3.375E+01	3.324E+01
1250	7.980E+01	7.929E+01	3.524E+01	4.576E+01	4.522E+01	2.198E+01	3.173E+01	3.130E+01
1500	7.821E+01	7.780E+01	3.446E+01	4.479E+01	4.438E+01	2.162E+01	3.126E+01	3.085E+01
1750	7.752E+01	7.719E+01	3.402E+01	4.428E+01	4.381E+01	2.129E+01	3.084E+01	3.032E+01
2000	7.703E+01	7.668E+01	3.381E+01	4.408E+01	4.369E+01	2.118E+01	3.079E+01	3.032E+01
2250	7.710E+01	7.663E+01	3.365E+01	4.379E+01	4.335E+01	2.096E+01	3.040E+01	2.989E+01
2500	7.716E+01	7.688E+01	3.382E+01	4.425E+01	4.385E+01	2.115E+01	3.079E+01	3.038E+01
2750	7.742E+01	7.697E+01	3.383E+01	4.435E+01	4.392E+01	2.122E+01	3.097E+01	3.050E+01
3000	7.791E+01	7.749E+01	3.400E+01	4.470E+01	4.425E+01	2.134E+01	3.116E+01	3.073E+01

Table 47. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Silicon from Secondary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	2.409E-01	1.754E-01	4.636E-03	9.688E-05	1.154E-04	2.051E-04	2.430E-04	1.254E-04
35	9.487E-01	5.383E-01	1.586E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
40	2.512E+00	9.797E-01	2.833E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	4.442E+00	2.148E+00	5.413E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
50	3.556E+00	3.752E+00	8.556E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
55	2.720E+00	4.634E+00	1.294E-01	6.443E-03	6.269E-03	2.963E-03	2.093E-03	2.165E-03
60	2.759E+00	5.070E+00	2.090E-01	1.128E-02	1.001E-02	4.518E-03	5.119E-03	4.069E-03
65	2.120E+00	3.743E+00	3.397E-01	1.415E-02	1.188E-02	6.441E-03	5.338E-03	5.260E-03
70	1.965E+00	3.154E+00	5.150E-01	2.497E-02	2.306E-02	9.338E-03	8.759E-03	8.776E-03
75	1.716E+00	2.769E+00	6.845E-01	3.014E-02	2.769E-02	1.218E-02	1.209E-02	1.166E-02
80	1.645E+00	2.460E+00	8.805E-01	5.985E-02	5.502E-02	1.816E-02	1.581E-02	1.592E-02
85	1.613E+00	2.414E+00	1.101E+00	1.191E-01	1.107E-01	2.940E-02	2.201E-02	2.098E-02
90	1.350E+00	2.164E+00	1.333E+00	1.741E-01	1.658E-01	4.950E-02	3.423E-02	3.114E-02
95	1.205E+00	1.939E+00	1.569E+00	2.175E-01	2.077E-01	7.138E-02	4.561E-02	4.018E-02
100	1.240E+00	1.923E+00	1.750E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
110	1.283E+00	1.727E+00	2.384E+00	6.113E-01	5.895E-01	0.000E+00	0.000E+00	0.000E+00
120	1.247E+00	1.736E+00	2.975E+00	1.039E+00	1.018E+00	3.590E-01	3.065E-01	2.916E-01
130	1.173E+00	1.572E+00	3.582E+00	1.442E+00	1.420E+00	5.907E-01	5.425E-01	5.321E-01
140	1.205E+00	1.475E+00	4.247E+00	1.761E+00	1.740E+00	8.022E-01	8.897E-01	8.525E-01
150	1.222E+00	1.651E+00	4.925E+00	2.020E+00	1.999E+00	9.705E-01	1.204E+00	1.186E+00
160	1.041E+00	1.330E+00	5.599E+00	2.323E+00	2.286E+00	1.145E+00	1.503E+00	1.486E+00
170	1.089E+00	1.472E+00	6.396E+00	2.623E+00	2.617E+00	1.318E+00	1.761E+00	1.741E+00
180	1.058E+00	1.318E+00	7.044E+00	2.916E+00	2.913E+00	1.458E+00	1.987E+00	1.978E+00
190	1.380E+00	1.697E+00	7.865E+00	3.308E+00	3.253E+00	1.641E+00	2.299E+00	2.260E+00
200	1.415E+00	1.704E+00	8.662E+00	3.950E+00	3.823E+00	1.827E+00	2.503E+00	2.481E+00
300	1.464E+00	1.805E+00	8.871E+00	3.522E+01	3.718E+01	1.802E+01	1.051E+01	1.007E+01
400	1.354E+00	1.705E+00	6.459E+00	1.933E+01	2.040E+01	1.450E+01	3.022E+01	3.073E+01
500	1.307E+00	1.781E+00	5.629E+00	1.598E+01	1.733E+01	1.121E+01	2.139E+01	2.190E+01
600	1.331E+00	1.664E+00	5.208E+00	1.448E+01	1.605E+01	9.928E+00	1.896E+01	1.922E+01
700	1.440E+00	1.663E+00	4.983E+00	1.371E+01	1.530E+01	9.298E+00	1.781E+01	1.819E+01
800	1.439E+00	1.634E+00	4.821E+00	1.316E+01	1.476E+01	8.829E+00	1.801E+01	1.746E+01
900	1.369E+00	1.690E+00	4.609E+00	1.306E+01	1.565E+01	8.221E+00	1.611E+01	1.704E+01
1000	1.356E+00	1.719E+00	4.443E+00	1.237E+01	1.472E+01	7.945E+00	1.816E+01	1.738E+01
1250	1.388E+00	1.779E+00	4.277E+00	1.190E+01	1.469E+01	7.768E+00	1.547E+01	1.606E+01
1500	1.336E+00	1.708E+00	4.126E+00	1.146E+01	1.446E+01	7.510E+00	1.585E+01	1.576E+01
1750	1.422E+00	1.747E+00	4.043E+00	1.146E+01	1.363E+01	7.434E+00	1.503E+01	1.593E+01
2000	1.386E+00	1.792E+00	3.997E+00	1.109E+01	1.362E+01	7.304E+00	1.540E+01	1.599E+01
2250	1.461E+00	1.806E+00	3.989E+00	1.137E+01	1.355E+01	7.348E+00	1.632E+01	1.595E+01
2500	1.369E+00	1.644E+00	3.945E+00	1.098E+01	1.398E+01	7.240E+00	1.496E+01	1.542E+01
2750	1.268E+00	1.788E+00	3.933E+00	1.097E+01	1.339E+01	7.216E+00	1.482E+01	1.622E+01
3000	1.275E+00	1.558E+00	3.939E+00	1.104E+01	1.419E+01	7.247E+00	1.609E+01	1.571E+01

Table 48. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Phosphorus from Primary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
35	1.055E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
40	1.368E+03	3.496E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	9.168E+02	6.783E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
50	7.351E+02	9.303E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
55	6.287E+02	1.147E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	5.578E+02	7.342E+02	1.123E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
65	5.046E+02	6.077E+02	1.700E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
70	4.626E+02	5.332E+02	2.170E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
75	4.292E+02	4.802E+02	2.577E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
80	4.025E+02	4.409E+02	2.956E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
85	3.790E+02	4.090E+02	3.310E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
90	3.704E+02	3.970E+02	3.454E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
95	3.417E+02	3.612E+02	3.972E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
100	3.267E+02	3.430E+02	4.274E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
110	3.011E+02	3.126E+02	4.861E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
120	2.797E+02	2.886E+02	5.412E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
130	2.629E+02	2.692E+02	5.925E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
140	2.480E+02	2.533E+02	6.427E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
150	2.356E+02	2.393E+02	6.862E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
160	2.244E+02	2.275E+02	7.317E+01	0.000E+00	0.000E+00	7.437E-05	0.000E+00	0.000E+00
170	2.149E+02	2.176E+02	7.728E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
180	2.064E+02	2.083E+02	8.121E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
190	1.993E+02	2.005E+02	8.520E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
200	1.925E+02	1.935E+02	8.858E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
300	1.498E+02	1.497E+02	9.029E+01	2.228E+02	2.406E+02	3.581E+01	0.000E+00	0.000E+00
400	1.290E+02	1.287E+02	6.483E+01	9.825E+01	9.812E+01	5.820E+01	1.055E+02	1.069E+02
500	1.169E+02	1.163E+02	5.539E+01	7.711E+01	7.660E+01	4.034E+01	6.167E+01	6.113E+01
600	1.088E+02	1.084E+02	5.002E+01	6.728E+01	6.673E+01	3.381E+01	4.994E+01	4.937E+01
700	1.037E+02	1.031E+02	4.677E+01	6.149E+01	6.084E+01	3.046E+01	4.436E+01	4.371E+01
800	9.960E+01	9.917E+01	4.447E+01	5.781E+01	5.737E+01	2.835E+01	4.088E+01	4.029E+01
900	9.707E+01	9.645E+01	4.285E+01	5.518E+01	5.467E+01	2.681E+01	3.848E+01	3.797E+01
1000	9.464E+01	9.414E+01	4.165E+01	5.341E+01	5.282E+01	2.574E+01	3.690E+01	3.638E+01
1250	9.154E+01	9.079E+01	3.961E+01	5.029E+01	4.977E+01	2.405E+01	3.432E+01	3.375E+01
1500	8.961E+01	8.921E+01	3.898E+01	4.971E+01	4.915E+01	2.363E+01	3.388E+01	3.333E+01
1750	8.883E+01	8.839E+01	3.829E+01	4.882E+01	4.832E+01	2.322E+01	3.325E+01	3.279E+01
2000	8.850E+01	8.793E+01	3.832E+01	4.905E+01	4.854E+01	2.335E+01	3.353E+01	3.309E+01
2250	8.873E+01	8.777E+01	3.807E+01	4.891E+01	4.835E+01	2.324E+01	3.350E+01	3.300E+01
2500	8.871E+01	8.814E+01	3.814E+01	4.896E+01	4.846E+01	2.321E+01	3.333E+01	3.288E+01
2750	8.901E+01	8.835E+01	3.823E+01	4.905E+01	4.856E+01	2.320E+01	3.348E+01	3.297E+01
3000	8.948E+01	8.886E+01	3.836E+01	4.936E+01	4.887E+01	2.330E+01	3.380E+01	3.325E+01

Table 49. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Phosphorus from Secondary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	2.125E-01	1.836E-01	5.049E-03	3.227E-04	1.179E-04	2.935E-04	3.524E-04	2.624E-04
35	1.123E+00	4.760E-01	1.773E-02	9.336E-04	6.473E-04	7.003E-04	7.450E-04	0.000E+00
40	2.717E+00	9.811E-01	3.105E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	5.045E+00	2.211E+00	5.991E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
50	4.038E+00	3.898E+00	9.122E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
55	3.494E+00	5.672E+00	1.438E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	2.800E+00	5.825E+00	2.073E-01	1.123E-02	9.505E-03	4.820E-03	0.000E+00	0.000E+00
65	2.602E+00	4.679E+00	3.589E-01	2.009E-02	1.585E-02	7.935E-03	8.148E-03	7.262E-03
70	2.298E+00	3.767E+00	5.339E-01	2.347E-02	2.121E-02	1.122E-02	9.397E-03	9.106E-03
75	2.014E+00	3.556E+00	7.611E-01	3.957E-02	3.295E-02	1.430E-02	1.437E-02	1.315E-02
80	1.846E+00	2.941E+00	9.610E-01	6.115E-02	5.593E-02	1.890E-02	1.758E-02	1.618E-02
85	1.859E+00	2.828E+00	1.213E+00	1.323E-01	1.218E-01	3.327E-02	2.628E-02	2.478E-02
90	1.697E+00	2.460E+00	1.477E+00	1.912E-01	1.898E-01	5.218E-02	3.674E-02	3.070E-02
95	1.643E+00	2.489E+00	1.742E+00	2.455E-01	2.380E-01	8.122E-02	4.792E-02	4.692E-02
100	1.462E+00	2.246E+00	2.021E+00	3.332E-01	3.208E-01	1.115E-01	7.362E-02	1.447E-02
110	1.346E+00	2.104E+00	2.664E+00	6.617E-01	6.425E-01	2.166E-01	1.847E-01	1.799E-01
120	1.313E+00	1.890E+00	3.297E+00	1.150E+00	1.112E+00	4.018E-01	3.418E-01	3.310E-01
130	1.250E+00	1.812E+00	4.013E+00	1.507E+00	1.478E+00	6.271E-01	6.084E-01	5.749E-01
140	1.314E+00	1.781E+00	4.683E+00	1.795E+00	1.779E+00	8.287E-01	9.300E-01	8.942E-01
150	1.319E+00	1.713E+00	5.618E+00	2.164E+00	2.146E+00	1.052E+00	1.334E+00	1.288E+00
160	1.173E+00	1.577E+00	6.440E+00	2.461E+00	2.444E+00	1.229E+00	1.634E+00	1.586E+00
170	1.200E+00	1.497E+00	7.320E+00	2.779E+00	2.744E+00	1.401E+00	1.965E+00	1.878E+00
180	1.280E+00	1.544E+00	8.259E+00	3.091E+00	3.056E+00	1.574E+00	2.140E+00	2.141E+00
190	1.104E+00	1.571E+00	8.075E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
200	1.203E+00	1.611E+00	1.009E+01	3.937E+00	3.896E+00	1.907E+00	2.646E+00	2.659E+00
300	1.649E+00	1.920E+00	1.175E+01	5.116E+01	5.529E+01	1.850E+01	8.588E+00	8.433E+00
400	1.455E+00	1.775E+00	8.315E+00	2.510E+01	2.617E+01	1.924E+01	4.132E+01	4.237E+01
500	1.424E+00	1.747E+00	7.214E+00	2.079E+01	2.204E+01	1.457E+01	2.785E+01	2.839E+01
600	1.494E+00	1.746E+00	6.667E+00	1.869E+01	2.015E+01	1.280E+01	2.412E+01	2.460E+01
700	1.458E+00	1.701E+00	6.332E+00	1.767E+01	1.957E+01	1.188E+01	2.231E+01	2.267E+01
800	1.558E+00	1.889E+00	6.039E+00	1.659E+01	1.839E+01	1.125E+01	2.131E+01	2.200E+01
900	1.390E+00	1.823E+00	5.753E+00	1.589E+01	1.810E+01	1.050E+01	2.011E+01	2.047E+01
1000	1.429E+00	1.800E+00	5.636E+00	1.585E+01	1.823E+01	1.004E+01	1.969E+01	2.060E+01
1250	1.487E+00	1.828E+00	5.479E+00	1.519E+01	1.744E+01	9.776E+00	1.974E+01	1.978E+01
1500	1.258E+00	1.644E+00	5.203E+00	1.468E+01	1.733E+01	9.558E+00	1.938E+01	1.974E+01
1750	1.426E+00	1.754E+00	5.171E+00	1.441E+01	1.732E+01	9.412E+00	1.861E+01	1.937E+01
2000	1.392E+00	1.729E+00	4.994E+00	1.401E+01	1.643E+01	9.194E+00	1.944E+01	1.923E+01
2250	1.269E+00	1.685E+00	5.023E+00	1.406E+01	1.702E+01	9.167E+00	1.921E+01	1.927E+01
2500	1.386E+00	1.712E+00	4.981E+00	1.401E+01	1.690E+01	9.147E+00	1.891E+01	1.905E+01
2750	1.306E+00	1.757E+00	4.995E+00	1.412E+01	1.694E+01	9.173E+00	1.872E+01	1.965E+01
3000	1.290E+00	1.659E+00	4.969E+00	1.425E+01	1.653E+01	9.123E+00	1.847E+01	1.873E+01

Table 50. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Sulfur from Primary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
35	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
40	2.189E+03	1.286E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	1.164E+03	5.861E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
50	8.893E+02	8.743E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
55	7.479E+02	1.114E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	6.551E+02	9.687E+02	6.610E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
65	5.884E+02	7.470E+02	1.438E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
70	5.381E+02	6.375E+02	1.986E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
75	4.977E+02	5.685E+02	2.453E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
80	4.646E+02	5.174E+02	2.871E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
85	4.372E+02	4.777E+02	3.262E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
90	4.127E+02	4.450E+02	3.617E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
95	3.925E+02	4.185E+02	3.967E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
100	3.748E+02	3.960E+02	4.297E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
110	3.450E+02	3.594E+02	4.925E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
120	3.203E+02	3.312E+02	5.508E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
130	3.002E+02	3.088E+02	6.057E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
140	2.830E+02	2.897E+02	6.586E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
150	2.691E+02	2.736E+02	7.086E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
160	2.563E+02	2.602E+02	7.573E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
170	2.457E+02	2.489E+02	8.030E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
180	2.359E+02	2.382E+02	8.459E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
190	2.266E+02	2.293E+02	8.873E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
200	2.194E+02	2.210E+02	9.237E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
300	1.708E+02	1.706E+02	1.209E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
400	1.468E+02	1.467E+02	7.470E+01	1.163E+02	1.164E+02	7.643E+01	1.784E+02	1.950E+02
500	1.331E+02	1.326E+02	6.359E+01	8.968E+01	8.923E+01	4.767E+01	7.434E+01	7.376E+01
600	1.240E+02	1.236E+02	5.717E+01	7.724E+01	7.661E+01	3.919E+01	5.829E+01	5.766E+01
700	1.179E+02	1.173E+02	5.317E+01	7.008E+01	6.956E+01	3.486E+01	5.089E+01	5.030E+01
800	1.132E+02	1.127E+02	5.055E+01	6.569E+01	6.515E+01	3.232E+01	4.687E+01	4.617E+01
900	1.104E+02	1.097E+02	4.872E+01	6.278E+01	6.223E+01	3.047E+01	4.370E+01	4.312E+01
1000	1.077E+02	1.070E+02	4.718E+01	6.041E+01	5.990E+01	2.919E+01	4.180E+01	4.122E+01
1250	1.041E+02	1.034E+02	4.515E+01	5.759E+01	5.700E+01	2.741E+01	3.915E+01	3.853E+01
1500	1.020E+02	1.015E+02	4.402E+01	5.583E+01	5.528E+01	2.660E+01	3.796E+01	3.738E+01
1750	1.012E+02	1.006E+02	4.347E+01	5.535E+01	5.482E+01	2.624E+01	3.757E+01	3.702E+01
2000	1.007E+02	1.001E+02	4.336E+01	5.542E+01	5.484E+01	2.632E+01	3.771E+01	3.716E+01
2250	1.007E+02	9.982E+01	4.317E+01	5.522E+01	5.451E+01	2.611E+01	3.751E+01	3.696E+01
2500	1.007E+02	1.003E+02	4.330E+01	5.532E+01	5.479E+01	2.619E+01	3.777E+01	3.724E+01
2750	1.013E+02	1.006E+02	4.342E+01	5.588E+01	5.529E+01	2.642E+01	3.801E+01	3.740E+01
3000	1.018E+02	1.011E+02	4.354E+01	5.592E+01	5.531E+01	2.639E+01	3.807E+01	3.751E+01

Table 51. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Sulfur from Secondary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	2.044E-01	1.713E-01	4.863E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
35	8.242E-01	4.228E-01	1.550E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
40	1.949E+00	9.093E-01	2.988E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	5.242E+00	1.837E+00	5.491E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
50	4.631E+00	3.464E+00	8.693E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
55	3.785E+00	5.079E+00	1.321E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	3.235E+00	6.533E+00	1.899E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
65	2.841E+00	5.678E+00	2.900E-01	1.574E-02	1.347E-02	6.287E-03	7.282E-03	5.683E-03
70	2.621E+00	4.474E+00	4.749E-01	2.179E-02	2.033E-02	9.477E-03	0.000E+00	0.000E+00
75	2.246E+00	3.885E+00	6.707E-01	3.080E-02	2.985E-02	1.241E-02	1.289E-02	1.170E-02
80	2.237E+00	3.460E+00	8.817E-01	6.365E-02	5.700E-02	1.690E-02	1.551E-02	1.566E-02
85	1.829E+00	3.035E+00	1.082E+00	1.186E-01	1.078E-01	2.735E-02	1.985E-02	2.057E-02
90	1.885E+00	3.036E+00	1.367E+00	1.896E-01	1.775E-01	4.910E-02	2.732E-02	3.083E-02
95	1.817E+00	2.697E+00	1.623E+00	2.333E-01	2.293E-01	7.754E-02	4.265E-02	3.868E-02
100	1.709E+00	2.514E+00	1.877E+00	3.196E-01	2.992E-01	1.101E-01	7.184E-02	6.765E-02
110	1.605E+00	2.247E+00	2.491E+00	6.077E-01	5.803E-01	1.989E-01	1.745E-01	1.722E-01
120	1.450E+00	2.116E+00	3.126E+00	1.082E+00	1.060E+00	3.749E-01	3.200E-01	2.995E-01
130	1.209E+00	1.971E+00	3.848E+00	1.448E+00	1.409E+00	5.790E-01	5.450E-01	5.320E-01
140	1.490E+00	1.853E+00	4.576E+00	1.754E+00	1.729E+00	8.064E-01	8.872E-01	8.670E-01
150	1.280E+00	1.675E+00	5.304E+00	2.047E+00	2.019E+00	9.893E-01	1.235E+00	1.225E+00
160	1.307E+00	1.752E+00	6.053E+00	2.346E+00	2.312E+00	1.162E+00	1.529E+00	1.511E+00
170	1.322E+00	1.600E+00	6.927E+00	2.653E+00	2.605E+00	1.333E+00	1.813E+00	1.784E+00
180	1.291E+00	1.643E+00	7.825E+00	2.922E+00	2.900E+00	1.480E+00	2.031E+00	2.022E+00
190	1.369E+00	1.759E+00	8.751E+00	3.229E+00	3.197E+00	1.639E+00	2.337E+00	2.304E+00
200	1.265E+00	1.661E+00	9.861E+00	3.624E+00	3.596E+00	1.824E+00	2.564E+00	2.542E+00
300	1.542E+00	2.030E+00	1.488E+01	6.704E+01	6.055E+01	9.820E+00	0.000E+00	0.000E+00
400	1.474E+00	1.877E+00	9.340E+00	2.895E+01	3.011E+01	2.364E+01	5.954E+01	6.117E+01
500	1.435E+00	1.866E+00	7.902E+00	2.298E+01	2.437E+01	1.627E+01	3.164E+01	3.184E+01
600	1.333E+00	1.816E+00	7.345E+00	2.070E+01	2.219E+01	1.417E+01	2.697E+01	2.704E+01
700	1.749E+00	1.796E+00	6.980E+00	1.938E+01	2.100E+01	1.307E+01	2.489E+01	2.503E+01
800	1.526E+00	1.973E+00	6.585E+00	1.829E+01	1.992E+01	1.230E+01	2.333E+01	2.359E+01
900	1.577E+00	1.768E+00	6.399E+00	1.759E+01	1.967E+01	1.177E+01	2.218E+01	2.323E+01
1000	1.385E+00	1.881E+00	6.237E+00	1.751E+01	1.965E+01	1.103E+01	2.101E+01	2.139E+01
1250	1.512E+00	1.825E+00	5.885E+00	1.649E+01	1.875E+01	1.051E+01	2.213E+01	2.138E+01
1500	1.482E+00	1.924E+00	5.786E+00	1.608E+01	1.900E+01	1.042E+01	2.036E+01	2.167E+01
1750	1.564E+00	1.779E+00	5.643E+00	1.561E+01	1.811E+01	1.021E+01	1.969E+01	2.106E+01
2000	1.354E+00	1.678E+00	5.503E+00	1.565E+01	1.817E+01	1.007E+01	2.207E+01	2.126E+01
2250	1.328E+00	1.676E+00	5.519E+00	1.539E+01	1.792E+01	1.003E+01	2.096E+01	2.122E+01
2500	1.316E+00	1.680E+00	5.429E+00	1.525E+01	1.812E+01	9.949E+00	2.106E+01	2.053E+01
2750	1.310E+00	1.651E+00	5.363E+00	1.515E+01	1.807E+01	9.854E+00	1.971E+01	2.098E+01
3000	1.391E+00	1.664E+00	5.406E+00	1.527E+01	1.790E+01	9.944E+00	2.163E+01	2.091E+01

Table 52. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Chlorine from Primary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
35	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
40	3.004E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	1.371E+03	5.937E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
50	1.028E+03	9.201E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
55	8.559E+02	1.192E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	7.481E+02	1.187E+03	4.472E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
65	6.692E+02	8.703E+02	1.434E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
70	6.114E+02	7.351E+02	2.071E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
75	5.650E+02	6.515E+02	2.598E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
80	5.273E+02	5.896E+02	3.064E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
85	4.952E+02	5.444E+02	3.491E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
90	4.683E+02	5.059E+02	3.899E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
95	4.449E+02	4.752E+02	4.278E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
100	4.248E+02	4.500E+02	4.648E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
110	3.902E+02	4.078E+02	5.336E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
120	3.618E+02	3.751E+02	5.976E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
130	3.392E+02	3.489E+02	6.587E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
140	3.203E+02	3.276E+02	7.161E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
150	3.036E+02	3.096E+02	7.729E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
160	2.897E+02	2.947E+02	8.239E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
170	2.774E+02	2.810E+02	8.717E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
180	2.663E+02	2.694E+02	9.179E+01	0.000E+00	0.000E+00	1.621E-04	0.000E+00	0.000E+00
190	2.563E+02	2.589E+02	9.658E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
200	2.477E+02	2.494E+02	1.008E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
300	1.925E+02	1.926E+02	1.313E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
400	1.657E+02	1.654E+02	8.392E+01	1.311E+02	1.313E+02	9.255E+01	2.938E+02	4.916E+02
500	1.500E+02	1.495E+02	7.113E+01	9.926E+01	9.875E+01	5.272E+01	8.255E+01	8.204E+01
600	1.398E+02	1.395E+02	6.386E+01	8.528E+01	8.466E+01	4.323E+01	6.400E+01	6.334E+01
700	1.331E+02	1.326E+02	5.948E+01	7.756E+01	7.685E+01	3.832E+01	5.566E+01	5.502E+01
800	1.280E+02	1.273E+02	5.644E+01	7.233E+01	7.160E+01	3.533E+01	5.086E+01	5.015E+01
900	1.246E+02	1.237E+02	5.419E+01	6.864E+01	6.809E+01	3.317E+01	4.727E+01	4.661E+01
1000	1.215E+02	1.208E+02	5.267E+01	6.655E+01	6.577E+01	3.196E+01	4.542E+01	4.481E+01
1250	1.177E+02	1.165E+02	5.022E+01	6.288E+01	6.214E+01	2.980E+01	4.213E+01	4.151E+01
1500	1.153E+02	1.145E+02	4.902E+01	6.110E+01	6.048E+01	2.884E+01	4.090E+01	4.021E+01
1750	1.143E+02	1.135E+02	4.846E+01	6.071E+01	6.008E+01	2.861E+01	4.074E+01	4.003E+01
2000	1.137E+02	1.129E+02	4.831E+01	6.049E+01	5.986E+01	2.840E+01	4.044E+01	3.991E+01
2250	1.137E+02	1.127E+02	4.825E+01	6.074E+01	6.013E+01	2.853E+01	4.086E+01	4.023E+01
2500	1.138E+02	1.130E+02	4.816E+01	6.047E+01	5.979E+01	2.848E+01	4.073E+01	4.014E+01
2750	1.140E+02	1.136E+02	4.836E+01	6.109E+01	6.041E+01	2.859E+01	4.080E+01	4.021E+01
3000	1.147E+02	1.139E+02	4.843E+01	6.111E+01	6.047E+01	2.873E+01	4.124E+01	4.066E+01

Table 53. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Chlorine from Secondary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	2.074E-01	1.806E-01	5.241E-03	5.826E-04	5.306E-04	2.081E-04	1.259E-04	3.094E-04
35	7.876E-01	4.124E-01	1.669E-02	1.117E-03	8.273E-04	8.037E-04	0.000E+00	0.000E+00
40	2.342E+00	9.033E-01	3.916E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	6.489E+00	1.891E+00	5.830E-02	6.389E-03	3.714E-03	2.034E-03	8.875E-04	1.272E-03
50	6.089E+00	3.989E+00	9.351E-02	5.158E-03	4.683E-03	3.225E-03	2.665E-03	2.634E-03
55	4.519E+00	5.920E+00	1.336E-01	8.835E-03	7.719E-03	3.862E-03	0.000E+00	0.000E+00
60	4.071E+00	7.669E+00	1.967E-01	1.302E-02	1.211E-02	5.436E-03	4.994E-03	4.306E-03
65	3.470E+00	7.098E+00	2.933E-01	1.806E-02	1.575E-02	7.762E-03	7.012E-03	0.000E+00
70	3.123E+00	5.695E+00	4.847E-01	2.680E-02	2.287E-02	0.000E+00	0.000E+00	0.000E+00
75	2.820E+00	4.774E+00	6.968E-01	4.199E-02	3.524E-02	0.000E+00	0.000E+00	0.000E+00
80	2.590E+00	4.302E+00	9.478E-01	6.970E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00
85	2.121E+00	3.578E+00	1.186E+00	1.268E-01	1.167E-01	3.023E-02	2.539E-02	2.311E-02
90	2.263E+00	3.583E+00	1.467E+00	2.222E-01	2.045E-01	5.503E-02	3.525E-02	3.135E-02
95	2.025E+00	3.320E+00	1.793E+00	2.780E-01	2.713E-01	8.770E-02	4.339E-02	4.109E-02
100	2.036E+00	3.039E+00	2.080E+00	3.636E-01	3.383E-01	1.233E-01	7.852E-02	7.159E-02
110	1.802E+00	2.774E+00	2.719E+00	6.722E-01	6.445E-01	2.218E-01	2.046E-01	2.039E-01
120	1.744E+00	2.417E+00	3.451E+00	1.101E+00	1.067E+00	3.900E-01	3.311E-01	3.285E-01
130	1.738E+00	2.453E+00	4.227E+00	1.515E+00	1.490E+00	6.162E-01	5.749E-01	5.649E-01
140	1.536E+00	2.230E+00	5.080E+00	1.861E+00	1.831E+00	8.471E-01	0.000E+00	0.000E+00
150	1.400E+00	2.167E+00	5.854E+00	2.089E+00	2.078E+00	1.029E+00	1.272E+00	1.257E+00
160	1.334E+00	2.040E+00	6.734E+00	2.448E+00	2.404E+00	1.234E+00	1.634E+00	1.615E+00
170	1.509E+00	2.092E+00	7.867E+00	2.739E+00	2.718E+00	1.395E+00	1.914E+00	1.902E+00
180	1.520E+00	2.056E+00	8.962E+00	3.102E+00	3.089E+00	1.570E+00	2.198E+00	2.163E+00
190	1.379E+00	1.956E+00	9.941E+00	3.366E+00	3.326E+00	0.000E+00	0.000E+00	0.000E+00
200	1.464E+00	1.915E+00	9.943E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
300	1.566E+00	1.935E+00	1.955E+01	6.227E+01	5.493E+01	1.068E+01	6.828E+00	6.730E+00
400	1.553E+00	2.082E+00	1.152E+01	3.588E+01	3.696E+01	3.137E+01	8.720E+01	9.393E+01
500	1.502E+00	1.900E+00	9.850E+00	2.880E+01	3.027E+01	2.029E+01	3.932E+01	3.976E+01
600	1.469E+00	2.001E+00	8.991E+00	2.537E+01	2.734E+01	1.739E+01	3.275E+01	3.329E+01
700	1.469E+00	1.915E+00	8.480E+00	2.370E+01	2.564E+01	1.598E+01	3.004E+01	3.049E+01
800	1.590E+00	2.017E+00	8.174E+00	2.280E+01	2.492E+01	1.522E+01	2.870E+01	2.916E+01
900	2.025E+00	2.250E+00	7.918E+00	2.192E+01	2.407E+01	1.458E+01	2.712E+01	2.811E+01
1000	1.482E+00	1.810E+00	7.692E+00	2.120E+01	2.323E+01	1.391E+01	2.655E+01	2.724E+01
1250	1.545E+00	1.922E+00	7.341E+00	2.057E+01	2.327E+01	1.312E+01	2.566E+01	2.613E+01
1500	1.446E+00	1.841E+00	7.097E+00	1.967E+01	2.255E+01	1.275E+01	2.449E+01	2.553E+01
1750	1.407E+00	1.789E+00	6.917E+00	1.923E+01	2.217E+01	1.241E+01	2.405E+01	2.470E+01
2000	1.399E+00	1.812E+00	6.811E+00	1.919E+01	2.189E+01	1.237E+01	2.583E+01	2.450E+01
2250	1.484E+00	1.921E+00	6.721E+00	1.886E+01	2.172E+01	1.226E+01	2.515E+01	2.532E+01
2500	1.487E+00	1.784E+00	6.699E+00	1.880E+01	2.191E+01	1.219E+01	2.414E+01	2.482E+01
2750	1.397E+00	1.975E+00	6.674E+00	1.877E+01	2.178E+01	1.213E+01	2.400E+01	2.531E+01
3000	1.439E+00	1.886E+00	6.743E+00	1.915E+01	2.175E+01	1.227E+01	2.442E+01	2.515E+01

Table 54. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Argon from Primary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
35	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
40	2.903E+03	1.147E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	1.494E+03	7.109E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
50	1.135E+03	1.075E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
55	9.501E+02	1.379E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	8.328E+02	1.261E+03	7.155E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
65	7.475E+02	9.543E+02	1.733E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
70	6.818E+02	8.138E+02	2.433E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
75	6.309E+02	7.231E+02	3.021E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
80	5.883E+02	6.564E+02	3.545E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
85	5.538E+02	6.048E+02	4.023E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
90	5.241E+02	5.650E+02	4.492E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
95	4.977E+02	5.305E+02	4.915E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
100	4.748E+02	5.015E+02	5.328E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
110	4.359E+02	4.553E+02	6.099E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
120	4.050E+02	4.194E+02	6.817E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
130	3.804E+02	3.905E+02	7.498E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
140	3.583E+02	3.665E+02	8.130E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
150	3.400E+02	3.465E+02	8.738E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
160	3.245E+02	3.289E+02	9.333E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
170	3.108E+02	3.143E+02	9.882E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
180	2.977E+02	3.009E+02	1.037E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
190	2.874E+02	2.894E+02	1.087E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
200	2.774E+02	2.791E+02	1.132E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
300	2.159E+02	2.159E+02	1.460E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
400	1.857E+02	1.853E+02	9.193E+01	1.389E+02	1.390E+02	9.205E+01	2.306E+02	2.643E+02
500	1.683E+02	1.674E+02	7.791E+01	1.059E+02	1.051E+02	5.557E+01	8.561E+01	8.505E+01
600	1.566E+02	1.561E+02	7.021E+01	9.166E+01	9.087E+01	4.587E+01	6.735E+01	6.658E+01
700	1.488E+02	1.483E+02	6.531E+01	8.293E+01	8.225E+01	4.085E+01	5.888E+01	5.809E+01
800	1.432E+02	1.424E+02	6.209E+01	7.752E+01	7.688E+01	3.751E+01	5.341E+01	5.277E+01
900	1.395E+02	1.386E+02	5.951E+01	7.379E+01	7.313E+01	3.570E+01	5.069E+01	4.990E+01
1000	1.362E+02	1.353E+02	5.785E+01	7.110E+01	7.039E+01	3.394E+01	4.791E+01	4.722E+01
1250	1.318E+02	1.305E+02	5.515E+01	6.711E+01	6.638E+01	3.154E+01	4.404E+01	4.340E+01
1500	1.289E+02	1.283E+02	5.390E+01	6.568E+01	6.499E+01	3.082E+01	4.328E+01	4.266E+01
1750	1.279E+02	1.272E+02	5.344E+01	6.523E+01	6.446E+01	3.053E+01	4.309E+01	4.246E+01
2000	1.271E+02	1.264E+02	5.303E+01	6.481E+01	6.415E+01	3.028E+01	4.276E+01	4.216E+01
2250	1.272E+02	1.264E+02	5.305E+01	6.517E+01	6.435E+01	3.035E+01	4.274E+01	4.215E+01
2500	1.274E+02	1.265E+02	5.299E+01	6.513E+01	6.455E+01	3.044E+01	4.308E+01	4.250E+01
2750	1.280E+02	1.272E+02	5.398E+01	6.520E+01	6.448E+01	3.037E+01	4.306E+01	4.240E+01
3000	1.287E+02	1.277E+02	5.337E+01	6.567E+01	6.503E+01	3.066E+01	4.358E+01	4.297E+01

Table 55. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Argon from Secondary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	2.214E-01	2.018E-01	6.476E-03	5.503E-04	5.785E-04	3.827E-04	3.894E-04	4.538E-04
35	7.958E-01	4.585E-01	2.055E-02	3.002E-03	2.042E-03	1.059E-03	9.016E-04	8.760E-04
40	2.982E+00	8.872E-01	3.795E-02	2.883E-03	2.542E-03	1.553E-03	1.914E-03	1.581E-03
45	7.551E+00	2.051E+00	6.961E-02	6.112E-03	4.685E-03	2.830E-03	3.101E-03	2.275E-03
50	7.737E+00	4.771E+00	1.044E-01	8.099E-03	7.074E-03	4.204E-03	3.914E-03	3.047E-03
55	6.182E+00	7.434E+00	1.475E-01	1.106E-02	1.064E-02	6.181E-03	5.416E-03	5.084E-03
60	4.882E+00	9.361E+00	2.256E-01	1.957E-02	1.701E-02	8.581E-03	7.027E-03	6.686E-03
65	4.330E+00	9.286E+00	3.377E-01	2.845E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00
70	3.756E+00	7.203E+00	5.798E-01	3.584E-02	3.015E-02	1.555E-02	1.520E-02	1.403E-02
75	3.383E+00	5.957E+00	8.775E-01	5.010E-02	4.867E-02	2.160E-02	2.330E-02	5.911E-03
80	3.007E+00	5.129E+00	1.165E+00	9.215E-02	8.514E-02	2.736E-02	2.785E-02	2.580E-02
85	2.924E+00	4.898E+00	1.445E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
90	2.641E+00	4.382E+00	1.711E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
95	2.484E+00	3.901E+00	2.064E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
100	2.483E+00	4.004E+00	2.462E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
110	2.349E+00	3.484E+00	3.379E+00	7.317E-01	7.023E-01	2.616E-01	2.646E-01	2.649E-01
120	2.116E+00	3.002E+00	4.284E+00	1.261E+00	1.220E+00	4.393E-01	3.875E-01	3.782E-01
130	1.981E+00	2.947E+00	5.239E+00	1.640E+00	1.606E+00	6.781E-01	6.462E-01	6.317E-01
140	2.002E+00	2.721E+00	6.257E+00	2.015E+00	1.965E+00	9.532E-01	1.038E+00	1.026E+00
150	1.858E+00	2.633E+00	7.372E+00	2.265E+00	2.261E+00	1.140E+00	1.481E+00	1.463E+00
160	1.911E+00	2.602E+00	8.501E+00	2.537E+00	2.524E+00	1.300E+00	1.787E+00	1.757E+00
170	1.669E+00	2.430E+00	9.699E+00	2.866E+00	2.865E+00	1.487E+00	2.111E+00	2.077E+00
180	1.777E+00	2.500E+00	1.111E+01	3.229E+00	3.231E+00	1.691E+00	2.403E+00	2.385E+00
190	1.659E+00	2.394E+00	1.139E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
200	1.667E+00	2.232E+00	1.284E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
300	1.784E+00	2.410E+00	2.742E+01	7.148E+01	5.824E+01	8.736E+00	0.000E+00	0.000E+00
400	1.680E+00	2.067E+00	1.589E+01	5.015E+01	5.145E+01	4.568E+01	1.284E+02	1.321E+02
500	1.597E+00	2.109E+00	1.327E+01	3.914E+01	4.045E+01	2.760E+01	5.347E+01	5.398E+01
600	1.664E+00	2.166E+00	1.206E+01	3.441E+01	3.597E+01	2.341E+01	4.399E+01	4.435E+01
700	1.830E+00	2.252E+00	1.073E+01	2.981E+01	3.208E+01	1.999E+01	3.658E+01	3.771E+01
800	1.830E+00	2.252E+00	1.073E+01	2.981E+01	3.208E+01	1.999E+01	3.658E+01	3.771E+01
900	2.132E+00	2.398E+00	1.046E+01	2.888E+01	3.131E+01	1.904E+01	3.526E+01	3.667E+01
1000	1.848E+00	2.395E+00	1.018E+01	2.831E+01	3.081E+01	1.859E+01	3.505E+01	3.560E+01
1250	1.553E+00	2.059E+00	9.714E+00	2.708E+01	2.968E+01	1.705E+01	3.173E+01	3.266E+01
1500	1.467E+00	2.025E+00	9.296E+00	2.583E+01	2.842E+01	1.649E+01	3.135E+01	3.201E+01
1750	1.531E+00	1.951E+00	9.116E+00	2.547E+01	2.875E+01	1.633E+01	3.142E+01	3.166E+01
2000	1.491E+00	1.965E+00	8.984E+00	2.515E+01	2.772E+01	1.618E+01	3.082E+01	3.173E+01
2250	1.496E+00	2.011E+00	8.931E+00	2.497E+01	2.754E+01	1.613E+01	3.178E+01	3.165E+01
2500	1.461E+00	1.901E+00	8.871E+00	2.488E+01	2.798E+01	1.608E+01	3.180E+01	3.169E+01
2750	1.414E+00	1.815E+00	9.209E+00	2.504E+01	2.764E+01	1.606E+01	3.249E+01	3.182E+01
3000	1.505E+00	1.933E+00	8.830E+00	2.497E+01	2.757E+01	1.603E+01	3.118E+01	3.190E+01

Table 56. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Potassium from Primary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
35	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
40	1.498E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	2.146E+03	4.146E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
50	1.430E+03	8.654E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
55	1.143E+03	1.200E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	9.804E+02	1.488E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
65	8.686E+02	1.288E+03	8.436E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
70	7.869E+02	1.007E+03	1.811E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
75	7.222E+02	8.662E+02	2.499E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
80	6.712E+02	7.721E+02	3.080E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
85	6.288E+02	7.053E+02	3.597E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
90	5.943E+02	6.526E+02	4.085E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
95	5.626E+02	6.099E+02	4.530E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
100	5.356E+02	5.740E+02	4.955E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
110	4.919E+02	5.183E+02	5.773E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
120	4.559E+02	4.752E+02	6.510E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
130	4.272E+02	4.419E+02	7.215E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
140	4.018E+02	4.132E+02	7.873E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
150	3.816E+02	3.904E+02	8.517E+01	0.000E+00	0.000E+00	3.222E-04	0.000E+00	0.000E+00
160	3.629E+02	3.704E+02	9.121E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
170	3.476E+02	3.527E+02	9.685E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
180	3.332E+02	3.382E+02	1.021E+02	0.000E+00	0.000E+00	4.903E-05	0.000E+00	0.000E+00
190	3.211E+02	3.247E+02	1.076E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
200	3.100E+02	3.133E+02	1.125E+02	0.000E+00	0.000E+00	1.841E-04	0.000E+00	0.000E+00
300	2.409E+02	2.411E+02	1.491E+02	0.000E+00	0.000E+00	2.941E-04	0.000E+00	0.000E+00
400	2.070E+02	2.066E+02	1.064E+02	1.755E+02	1.766E+02	1.126E+02	0.000E+00	0.000E+00
500	1.875E+02	1.865E+02	8.862E+01	1.250E+02	1.243E+02	6.824E+01	1.108E+02	1.108E+02
600	1.746E+02	1.741E+02	7.941E+01	1.060E+02	1.051E+02	5.392E+01	8.081E+01	8.000E+01
700	1.662E+02	1.654E+02	7.366E+01	9.529E+01	9.449E+01	4.724E+01	6.864E+01	6.783E+01
800	1.598E+02	1.590E+02	6.960E+01	8.795E+01	8.719E+01	4.297E+01	6.160E+01	6.085E+01
900	1.555E+02	1.545E+02	6.686E+01	8.380E+01	8.281E+01	4.043E+01	5.767E+01	5.687E+01
1000	1.519E+02	1.511E+02	6.518E+01	8.095E+01	8.003E+01	3.850E+01	5.423E+01	5.346E+01
1250	1.465E+02	1.454E+02	6.189E+01	7.625E+01	7.542E+01	3.595E+01	5.045E+01	4.969E+01
1500	1.438E+02	1.431E+02	6.056E+01	7.436E+01	7.345E+01	3.466E+01	4.867E+01	4.791E+01
1750	1.428E+02	1.417E+02	5.969E+01	7.343E+01	7.259E+01	3.453E+01	4.870E+01	4.796E+01
2000	1.421E+02	1.412E+02	5.957E+01	7.333E+01	7.251E+01	3.436E+01	4.860E+01	4.793E+01
2250	1.415E+02	1.406E+02	5.941E+01	7.338E+01	7.259E+01	3.428E+01	4.852E+01	4.782E+01
2500	1.422E+02	1.414E+02	5.943E+01	7.334E+01	7.253E+01	3.431E+01	4.861E+01	4.787E+01
2750	1.423E+02	1.414E+02	5.949E+01	7.364E+01	7.294E+01	3.441E+01	4.884E+01	4.811E+01
3000	1.432E+02	1.424E+02	5.965E+01	7.376E+01	7.292E+01	3.440E+01	4.897E+01	4.820E+01

Table 57. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Potassium from Secondary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	2.261E-01	2.071E-01	5.670E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
35	6.137E-01	4.156E-01	1.744E-02	1.526E-03	1.253E-03	7.610E-04	1.846E-03	1.181E-03
40	2.274E+00	9.029E-01	3.899E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	5.861E+00	1.544E+00	5.735E-02	3.846E-03	2.900E-03	1.900E-03	0.000E+00	0.000E+00
50	8.441E+00	3.459E+00	9.215E-02	7.414E-03	6.135E-03	3.199E-03	2.300E-03	2.359E-03
55	6.615E+00	5.945E+00	1.386E-01	9.368E-03	7.857E-03	4.264E-03	4.263E-03	4.698E-03
60	5.113E+00	8.070E+00	1.908E-01	1.461E-02	1.248E-02	5.119E-03	0.000E+00	0.000E+00
65	4.724E+00	9.693E+00	2.771E-01	1.882E-02	1.801E-02	8.276E-03	6.682E-03	6.173E-03
70	3.851E+00	8.039E+00	4.011E-01	2.320E-02	2.123E-02	1.066E-02	1.036E-02	9.730E-03
75	3.531E+00	6.473E+00	6.499E-01	3.927E-02	3.320E-02	1.471E-02	1.550E-02	1.579E-02
80	3.257E+00	5.755E+00	9.127E-01	7.122E-02	6.345E-02	2.032E-02	1.921E-02	1.767E-02
85	2.736E+00	4.899E+00	1.151E+00	1.348E-01	1.241E-01	3.077E-02	2.351E-02	2.127E-02
90	2.768E+00	4.516E+00	1.437E+00	2.041E-01	1.968E-01	5.459E-02	3.254E-02	3.081E-02
95	2.719E+00	4.137E+00	1.733E+00	2.674E-01	2.611E-01	8.564E-02	4.425E-02	4.150E-02
100	2.558E+00	3.987E+00	2.109E+00	3.824E-01	3.639E-01	1.324E-01	8.197E-02	7.560E-02
110	2.114E+00	3.253E+00	2.593E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
120	2.054E+00	3.193E+00	3.588E+00	1.053E+00	1.020E+00	3.660E-01	3.222E-01	3.167E-01
130	2.012E+00	3.037E+00	4.362E+00	1.474E+00	1.458E+00	5.901E-01	5.473E-01	5.342E-01
140	1.984E+00	2.811E+00	5.323E+00	1.801E+00	1.792E+00	8.344E-01	9.046E-01	8.853E-01
150	1.771E+00	2.696E+00	6.191E+00	2.094E+00	2.070E+00	1.037E+00	1.291E+00	1.275E+00
160	1.682E+00	2.536E+00	7.212E+00	2.395E+00	2.370E+00	1.220E+00	1.642E+00	1.610E+00
170	1.710E+00	2.542E+00	8.278E+00	2.725E+00	2.712E+00	1.404E+00	1.927E+00	1.909E+00
180	2.002E+00	2.629E+00	9.530E+00	3.111E+00	3.093E+00	1.603E+00	2.266E+00	2.258E+00
190	1.824E+00	2.493E+00	1.063E+01	3.283E+00	3.269E+00	1.722E+00	2.432E+00	2.444E+00
200	1.623E+00	2.175E+00	1.198E+01	3.648E+00	3.655E+00	1.900E+00	2.744E+00	2.725E+00
300	1.924E+00	2.494E+00	2.507E+01	3.263E+01	2.977E+01	6.900E+00	6.204E+00	6.107E+00
400	1.879E+00	2.203E+00	1.574E+01	5.137E+01	5.285E+01	4.788E+01	5.666E+01	5.338E+01
500	1.691E+00	2.189E+00	1.311E+01	3.862E+01	4.018E+01	2.780E+01	5.497E+01	5.552E+01
600	1.594E+00	2.183E+00	1.183E+01	3.398E+01	3.583E+01	2.325E+01	4.420E+01	4.446E+01
700	1.740E+00	2.316E+00	1.107E+01	3.122E+01	3.313E+01	2.097E+01	3.909E+01	3.943E+01
800	1.849E+00	2.412E+00	1.076E+01	2.993E+01	3.192E+01	1.990E+01	3.709E+01	3.760E+01
900	1.856E+00	2.364E+00	1.041E+01	2.901E+01	3.154E+01	1.904E+01	3.532E+01	3.616E+01
1000	1.900E+00	2.415E+00	9.981E+00	2.802E+01	3.085E+01	1.840E+01	3.466E+01	3.535E+01
1250	1.481E+00	1.959E+00	9.501E+00	2.647E+01	2.923E+01	1.669E+01	3.266E+01	3.262E+01
1500	1.583E+00	1.896E+00	9.138E+00	2.560E+01	2.826E+01	1.639E+01	3.177E+01	3.177E+01
1750	1.457E+00	1.889E+00	8.960E+00	2.513E+01	2.798E+01	1.605E+01	3.115E+01	3.144E+01
2000	1.389E+00	1.853E+00	8.785E+00	2.496E+01	2.816E+01	1.600E+01	3.088E+01	3.190E+01
2250	1.602E+00	1.921E+00	8.843E+00	2.480E+01	2.762E+01	1.601E+01	3.184E+01	3.171E+01
2500	1.440E+00	1.840E+00	8.728E+00	2.460E+01	2.729E+01	1.584E+01	3.104E+01	3.224E+01
2750	1.698E+00	2.023E+00	8.719E+00	2.458E+01	2.747E+01	1.578E+01	3.062E+01	3.140E+01
3000	1.673E+00	1.930E+00	8.738E+00	2.494E+01	2.744E+01	1.593E+01	3.193E+01	3.149E+01

Table 58. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Calcium from Primary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
35	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
40	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	3.246E+03	1.325E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
50	1.749E+03	7.464E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
55	1.343E+03	1.124E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	1.129E+03	1.440E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
65	9.903E+02	1.725E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
70	8.908E+02	1.221E+03	1.387E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
75	8.160E+02	1.015E+03	2.222E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
80	7.552E+02	8.910E+02	2.877E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
85	7.068E+02	8.068E+02	3.451E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
90	6.659E+02	7.426E+02	3.972E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
95	6.294E+02	6.915E+02	4.455E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
100	5.991E+02	6.489E+02	4.917E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
110	5.486E+02	5.823E+02	5.773E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
120	5.086E+02	5.329E+02	6.575E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
130	4.751E+02	4.937E+02	7.307E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
140	4.474E+02	4.616E+02	8.022E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
150	4.242E+02	4.346E+02	8.691E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
160	4.040E+02	4.122E+02	9.341E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
170	3.857E+02	3.929E+02	9.939E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
180	3.705E+02	3.761E+02	1.052E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
190	3.567E+02	3.608E+02	1.107E+02	0.000E+00	0.000E+00	6.280E-06	0.000E+00	0.000E+00
200	3.445E+02	3.473E+02	1.160E+02	0.000E+00	0.000E+00	5.569E-07	0.000E+00	0.000E+00
300	2.674E+02	2.671E+02	1.561E+02	0.000E+00	0.000E+00	3.210E-07	0.000E+00	0.000E+00
400	2.293E+02	2.291E+02	1.200E+02	2.101E+02	2.133E+02	1.015E+02	0.000E+00	0.000E+00
500	2.078E+02	2.070E+02	9.815E+01	1.393E+02	1.389E+02	7.865E+01	1.351E+02	1.361E+02
600	1.938E+02	1.930E+02	8.742E+01	1.156E+02	1.146E+02	5.933E+01	8.946E+01	8.873E+01
700	1.840E+02	1.833E+02	8.109E+01	1.041E+02	1.034E+02	5.172E+01	7.532E+01	7.437E+01
800	1.772E+02	1.763E+02	7.647E+01	9.565E+01	9.477E+01	4.654E+01	6.671E+01	6.595E+01
900	1.723E+02	1.713E+02	7.347E+01	9.085E+01	8.991E+01	4.367E+01	6.203E+01	6.110E+01
1000	1.682E+02	1.673E+02	7.117E+01	8.722E+01	8.633E+01	4.163E+01	5.870E+01	5.790E+01
1250	1.622E+02	1.613E+02	6.782E+01	8.226E+01	8.149E+01	3.879E+01	5.424E+01	5.348E+01
1500	1.594E+02	1.582E+02	6.628E+01	8.023E+01	7.942E+01	3.757E+01	5.248E+01	5.170E+01
1750	1.579E+02	1.571E+02	6.533E+01	7.904E+01	7.829E+01	3.693E+01	5.148E+01	5.068E+01
2000	1.572E+02	1.564E+02	6.518E+01	7.897E+01	7.810E+01	3.684E+01	5.193E+01	5.110E+01
2250	1.572E+02	1.563E+02	6.500E+01	7.935E+01	7.858E+01	3.703E+01	5.213E+01	5.142E+01
2500	1.572E+02	1.563E+02	6.508E+01	7.948E+01	7.869E+01	3.705E+01	5.237E+01	5.166E+01
2750	1.579E+02	1.570E+02	6.525E+01	7.981E+01	7.897E+01	3.715E+01	5.238E+01	5.159E+01
3000	1.589E+02	1.576E+02	6.537E+01	7.982E+01	7.891E+01	3.699E+01	5.208E+01	5.124E+01

Table 59. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Calcium from Secondary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	1.930E-01	1.894E-01	5.368E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
35	5.916E-01	4.353E-01	1.669E-02	8.668E-04	7.383E-04	5.821E-04	4.503E-04	5.530E-04
40	1.848E+00	7.070E-01	3.447E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	4.517E+00	1.454E+00	5.946E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
50	9.150E+00	2.976E+00	8.887E-02	7.167E-03	5.224E-03	2.736E-03	2.933E-03	2.051E-03
55	7.424E+00	5.637E+00	1.284E-01	7.449E-03	6.796E-03	3.977E-03	3.907E-03	3.941E-03
60	5.896E+00	7.984E+00	1.843E-01	1.364E-02	1.140E-02	5.172E-03	3.502E-03	3.514E-03
65	5.019E+00	9.438E+00	2.585E-01	1.596E-02	1.498E-02	6.159E-03	0.000E+00	0.000E+00
70	4.273E+00	9.426E+00	3.649E-01	2.250E-02	2.101E-02	1.028E-02	8.507E-03	8.131E-03
75	3.675E+00	7.537E+00	5.639E-01	3.367E-02	3.065E-02	1.290E-02	1.334E-02	1.286E-02
80	3.379E+00	6.378E+00	8.235E-01	8.454E-02	6.101E-02	1.946E-02	1.756E-02	1.654E-02
85	3.099E+00	5.369E+00	1.054E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
90	2.888E+00	4.930E+00	1.367E+00	1.946E-01	1.845E-01	4.955E-02	2.903E-02	2.749E-02
95	2.728E+00	4.354E+00	1.654E+00	2.734E-01	2.625E-01	8.329E-02	4.093E-02	3.785E-02
100	2.548E+00	4.207E+00	1.964E+00	3.420E-01	3.358E-01	1.209E-01	7.197E-02	6.579E-02
110	2.267E+00	3.646E+00	2.655E+00	5.891E-01	5.603E-01	2.083E-01	1.989E-01	1.908E-01
120	2.228E+00	3.454E+00	3.362E+00	9.710E-01	9.434E-01	3.411E-01	3.063E-01	3.011E-01
130	2.057E+00	3.113E+00	4.212E+00	1.451E+00	1.411E+00	5.684E-01	5.176E-01	4.991E-01
140	2.148E+00	3.036E+00	5.058E+00	1.749E+00	1.722E+00	8.049E-01	8.599E-01	8.298E-01
150	2.018E+00	2.882E+00	5.943E+00	2.062E+00	2.054E+00	5.514E-01	0.000E+00	0.000E+00
160	1.946E+00	2.699E+00	6.917E+00	2.331E+00	2.310E+00	1.185E+00	1.588E+00	1.569E+00
170	2.166E+00	2.742E+00	7.900E+00	2.588E+00	2.561E+00	1.347E+00	1.859E+00	1.864E+00
180	2.038E+00	2.617E+00	9.124E+00	2.973E+00	2.988E+00	1.542E+00	2.166E+00	2.156E+00
190	1.958E+00	2.750E+00	1.042E+01	3.204E+00	3.206E+00	1.669E+00	2.374E+00	2.364E+00
200	1.875E+00	2.615E+00	1.164E+01	3.524E+00	3.558E+00	1.846E+00	2.682E+00	2.641E+00
300	1.927E+00	2.700E+00	2.565E+01	2.471E+01	2.312E+01	5.920E+00	5.809E+00	5.839E+00
400	1.686E+00	2.258E+00	1.785E+01	5.962E+01	6.109E+01	4.795E+01	4.307E+01	4.040E+01
500	1.905E+00	2.343E+00	1.487E+01	4.424E+01	4.557E+01	3.209E+01	6.500E+01	6.589E+01
600	1.639E+00	2.077E+00	1.340E+01	3.849E+01	4.042E+01	2.634E+01	4.965E+01	5.006E+01
700	1.917E+00	2.340E+00	1.257E+01	3.518E+01	3.712E+01	2.374E+01	4.493E+01	4.490E+01
800	1.837E+00	2.436E+00	1.204E+01	3.377E+01	3.559E+01	2.234E+01	4.167E+01	4.192E+01
900	1.972E+00	2.388E+00	1.167E+01	3.255E+01	3.493E+01	2.141E+01	3.925E+01	4.047E+01
1000	1.807E+00	2.216E+00	1.121E+01	3.110E+01	3.362E+01	2.039E+01	3.898E+01	3.869E+01
1250	1.619E+00	2.021E+00	1.063E+01	2.959E+01	3.194E+01	1.850E+01	3.536E+01	3.526E+01
1500	1.618E+00	2.003E+00	1.029E+01	2.880E+01	3.152E+01	1.828E+01	3.456E+01	3.493E+01
1750	1.513E+00	1.953E+00	1.005E+01	2.810E+01	3.118E+01	1.798E+01	3.432E+01	3.486E+01
2000	1.519E+00	1.952E+00	9.875E+00	2.781E+01	3.053E+01	1.789E+01	3.366E+01	3.438E+01
2250	1.576E+00	1.842E+00	9.859E+00	2.758E+01	3.060E+01	1.768E+01	3.394E+01	3.492E+01
2500	1.689E+00	2.103E+00	9.745E+00	2.741E+01	3.055E+01	1.752E+01	3.366E+01	3.464E+01
2750	1.560E+00	2.007E+00	9.701E+00	2.722E+01	3.016E+01	1.743E+01	3.400E+01	3.470E+01
3000	1.648E+00	1.938E+00	9.734E+00	2.752E+01	3.059E+01	1.768E+01	3.581E+01	3.506E+01

Table 60. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Scandium from Primary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
35	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
40	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	3.158E+03	2.686E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
50	1.869E+03	8.847E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
55	1.454E+03	1.298E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	1.230E+03	1.648E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
65	1.083E+03	1.963E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
70	9.764E+02	1.311E+03	1.712E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
75	8.955E+02	1.102E+03	2.605E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
80	8.291E+02	9.715E+02	3.316E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
85	7.756E+02	8.818E+02	3.952E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
90	7.306E+02	8.113E+02	4.525E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
95	6.925E+02	7.558E+02	5.059E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
100	6.594E+02	7.119E+02	5.577E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
110	6.044E+02	6.401E+02	6.515E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
120	5.590E+02	5.851E+02	7.391E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
130	5.225E+02	5.416E+02	8.236E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
140	4.921E+02	5.068E+02	8.983E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
150	4.672E+02	4.779E+02	9.708E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
160	4.447E+02	4.537E+02	1.042E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
170	4.248E+02	4.325E+02	1.107E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
180	4.080E+02	4.139E+02	1.171E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
190	3.925E+02	3.977E+02	1.233E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
200	3.789E+02	3.825E+02	1.287E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
300	2.945E+02	2.947E+02	1.715E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
400	2.528E+02	2.526E+02	1.295E+02	2.180E+02	2.207E+02	1.140E+02	0.000E+00	0.000E+00
500	2.290E+02	2.276E+02	1.065E+02	1.477E+02	1.472E+02	8.212E+01	1.371E+02	1.378E+02
600	2.135E+02	2.124E+02	9.510E+01	1.239E+02	1.230E+02	6.302E+01	9.385E+01	9.318E+01
700	2.027E+02	2.018E+02	8.828E+01	1.117E+02	1.107E+02	5.509E+01	7.997E+01	7.903E+01
800	1.951E+02	1.940E+02	8.344E+01	1.030E+02	1.022E+02	4.979E+01	7.080E+01	6.993E+01
900	1.900E+02	1.889E+02	8.008E+01	9.737E+01	9.647E+01	4.657E+01	6.577E+01	6.499E+01
1000	1.855E+02	1.841E+02	7.758E+01	9.394E+01	9.306E+01	4.458E+01	6.243E+01	6.163E+01
1250	1.805E+02	1.792E+02	7.525E+01	9.065E+01	8.949E+01	4.258E+01	5.919E+01	5.832E+01
1500	1.756E+02	1.743E+02	7.229E+01	8.642E+01	8.550E+01	4.028E+01	5.590E+01	5.504E+01
1750	1.739E+02	1.730E+02	7.165E+01	8.579E+01	8.497E+01	3.992E+01	5.552E+01	5.470E+01
2000	1.733E+02	1.721E+02	7.102E+01	8.523E+01	8.436E+01	3.960E+01	5.528E+01	5.443E+01
2250	1.728E+02	1.719E+02	7.098E+01	8.537E+01	8.450E+01	3.953E+01	5.545E+01	5.467E+01
2500	1.735E+02	1.720E+02	7.094E+01	8.586E+01	8.490E+01	3.973E+01	5.559E+01	5.482E+01
2750	1.738E+02	1.729E+02	7.129E+01	8.612E+01	8.522E+01	3.986E+01	5.614E+01	5.521E+01
3000	1.750E+02	1.739E+02	7.134E+01	8.617E+01	8.515E+01	3.968E+01	5.558E+01	5.481E+01

Table 61. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Scandium from Secondary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	2.220E-01	1.947E-01	6.492E-03	6.075E-04	7.837E-04	3.159E-04	2.797E-04	3.014E-04
35	5.769E-01	4.187E-01	1.984E-02	8.769E-04	6.245E-04	8.965E-04	9.800E-04	8.082E-04
40	1.882E+00	6.956E-01	4.052E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	5.840E+00	1.378E+00	6.470E-02	4.799E-03	4.065E-03	2.279E-03	1.590E-03	1.619E-03
50	1.183E+01	3.472E+00	9.968E-02	6.622E-03	5.497E-03	3.612E-03	3.043E-03	3.087E-03
55	9.794E+00	7.211E+00	1.428E-01	1.217E-02	1.073E-02	5.526E-03	5.698E-03	4.785E-03
60	7.603E+00	1.029E+01	1.903E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
65	6.271E+00	1.256E+01	2.778E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
70	5.323E+00	1.231E+01	4.188E-01	3.231E-02	3.009E-02	1.496E-02	1.312E-02	1.237E-02
75	4.406E+00	8.954E+00	6.683E-01	4.563E-02	4.257E-02	1.957E-02	2.018E-02	1.893E-02
80	4.170E+00	7.880E+00	9.865E-01	8.375E-02	7.846E-02	2.470E-02	2.461E-02	2.457E-02
85	3.805E+00	6.868E+00	1.285E+00	1.637E-01	1.492E-01	3.897E-02	3.178E-02	3.336E-02
90	3.637E+00	6.317E+00	1.606E+00	2.469E-01	2.336E-01	6.644E-02	4.077E-02	4.066E-02
95	3.342E+00	5.622E+00	2.015E+00	3.299E-01	3.201E-01	1.061E-01	5.841E-02	5.833E-02
100	2.974E+00	4.978E+00	2.328E+00	4.261E-01	4.011E-01	1.439E-01	8.867E-02	8.364E-02
110	2.574E+00	4.265E+00	3.149E+00	7.188E-01	6.882E-01	2.561E-01	2.443E-01	2.367E-01
120	2.768E+00	4.218E+00	4.103E+00	1.128E+00	1.100E+00	4.042E-01	3.853E-01	3.756E-01
130	2.527E+00	3.983E+00	4.988E+00	1.593E+00	1.568E+00	0.000E+00	0.000E+00	0.000E+00
140	2.524E+00	3.807E+00	6.235E+00	1.962E+00	1.931E+00	9.109E-01	1.008E+00	9.901E-01
150	2.434E+00	3.650E+00	7.293E+00	2.256E+00	2.230E+00	1.131E+00	1.442E+00	1.419E+00
160	2.355E+00	3.492E+00	8.568E+00	2.517E+00	2.492E+00	1.289E+00	1.741E+00	1.723E+00
170	2.422E+00	3.417E+00	9.952E+00	2.876E+00	2.861E+00	1.485E+00	2.054E+00	2.065E+00
180	2.122E+00	3.146E+00	1.131E+01	3.148E+00	3.124E+00	1.638E+00	2.341E+00	2.327E+00
190	2.192E+00	3.224E+00	1.271E+01	3.448E+00	3.412E+00	1.779E+00	2.519E+00	2.530E+00
200	2.104E+00	3.103E+00	1.434E+01	3.823E+00	3.840E+00	2.002E+00	2.901E+00	2.915E+00
300	2.012E+00	2.786E+00	3.251E+01	1.888E+01	1.749E+01	5.284E+00	6.075E+00	6.013E+00
400	1.849E+00	2.592E+00	2.287E+01	7.797E+01	8.007E+01	6.188E+01	3.529E+01	3.258E+01
500	1.948E+00	2.449E+00	1.863E+01	5.619E+01	5.744E+01	4.107E+01	8.392E+01	8.522E+01
600	1.765E+00	2.421E+00	1.674E+01	4.843E+01	5.025E+01	3.324E+01	6.285E+01	6.347E+01
700	2.200E+00	2.654E+00	1.566E+01	4.394E+01	4.625E+01	2.960E+01	5.517E+01	5.551E+01
800	2.137E+00	2.692E+00	1.506E+01	4.191E+01	4.420E+01	2.797E+01	5.154E+01	5.230E+01
900	2.104E+00	2.736E+00	1.458E+01	4.041E+01	4.345E+01	2.665E+01	4.932E+01	4.991E+01
1000	2.058E+00	2.623E+00	1.407E+01	3.906E+01	4.157E+01	2.547E+01	4.731E+01	4.801E+01
1250	2.045E+00	2.537E+00	1.343E+01	3.760E+01	4.073E+01	2.443E+01	4.572E+01	4.665E+01
1500	1.640E+00	2.280E+00	1.286E+01	3.584E+01	3.853E+01	2.257E+01	4.260E+01	4.299E+01
1750	1.601E+00	2.168E+00	1.242E+01	3.497E+01	3.757E+01	2.215E+01	4.241E+01	4.272E+01
2000	1.542E+00	2.098E+00	1.242E+01	3.468E+01	3.778E+01	2.207E+01	4.306E+01	4.247E+01
2250	1.652E+00	2.155E+00	1.228E+01	3.442E+01	3.717E+01	2.199E+01	4.140E+01	4.280E+01
2500	1.780E+00	2.209E+00	1.225E+01	3.417E+01	3.707E+01	2.186E+01	4.211E+01	4.223E+01
2750	1.586E+00	2.180E+00	1.220E+01	3.425E+01	3.727E+01	2.183E+01	4.228E+01	4.259E+01
3000	1.771E+00	2.109E+00	1.225E+01	3.445E+01	3.797E+01	2.203E+01	4.207E+01	4.261E+01

Table 62. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Titanium from Primary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
35	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
40	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	3.999E+03	1.278E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
50	2.128E+03	8.785E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
55	1.632E+03	1.336E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	1.373E+03	1.713E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
65	1.203E+03	2.060E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
70	1.081E+03	1.496E+03	1.594E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
75	9.887E+02	1.236E+03	2.614E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
80	9.155E+02	1.085E+03	3.402E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
85	8.557E+02	9.793E+02	4.102E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
90	8.065E+02	8.999E+02	4.719E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
95	7.622E+02	8.371E+02	5.308E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
100	7.258E+02	7.862E+02	5.853E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
110	6.641E+02	7.048E+02	6.870E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
120	6.148E+02	6.441E+02	7.806E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
130	5.751E+02	5.968E+02	8.696E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
140	5.415E+02	5.580E+02	9.509E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
150	5.123E+02	5.253E+02	1.030E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
160	4.883E+02	4.986E+02	1.104E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
170	4.670E+02	4.748E+02	1.176E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
180	4.482E+02	4.541E+02	1.242E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
190	4.313E+02	4.364E+02	1.310E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
200	4.160E+02	4.208E+02	1.371E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
300	3.231E+02	3.231E+02	1.819E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
400	2.774E+02	2.766E+02	1.417E+02	2.426E+02	2.463E+02	1.116E+02	0.000E+00	0.000E+00
500	2.513E+02	2.502E+02	1.163E+02	1.605E+02	1.601E+02	9.009E+01	1.541E+02	1.556E+02
600	2.341E+02	2.329E+02	1.036E+02	1.336E+02	1.327E+02	6.787E+01	1.014E+02	1.004E+02
700	2.222E+02	2.212E+02	9.614E+01	1.202E+02	1.194E+02	5.940E+01	8.597E+01	8.512E+01
800	2.139E+02	2.127E+02	9.045E+01	1.103E+02	1.094E+02	5.331E+01	7.554E+01	7.462E+01
900	2.084E+02	2.069E+02	8.740E+01	1.053E+02	1.044E+02	5.030E+01	7.064E+01	6.986E+01
1000	2.035E+02	2.023E+02	8.435E+01	1.006E+02	9.943E+01	4.742E+01	6.644E+01	6.546E+01
1250	1.960E+02	1.948E+02	8.053E+01	9.512E+01	9.411E+01	4.447E+01	6.162E+01	6.083E+01
1500	1.925E+02	1.915E+02	7.834E+01	9.228E+01	9.132E+01	4.294E+01	5.945E+01	5.863E+01
1750	1.909E+02	1.897E+02	7.771E+01	9.171E+01	9.073E+01	4.254E+01	5.925E+01	5.833E+01
2000	1.901E+02	1.888E+02	7.718E+01	9.139E+01	9.048E+01	4.227E+01	5.877E+01	5.790E+01
2250	1.899E+02	1.887E+02	7.698E+01	9.143E+01	9.044E+01	4.223E+01	5.880E+01	5.792E+01
2500	1.904E+02	1.889E+02	7.728E+01	9.214E+01	9.112E+01	4.258E+01	5.958E+01	5.877E+01
2750	1.907E+02	1.897E+02	7.731E+01	9.205E+01	9.117E+01	4.256E+01	5.932E+01	5.849E+01
3000	1.921E+02	1.907E+02	7.745E+01	9.185E+01	9.087E+01	4.248E+01	5.943E+01	5.862E+01

Table 63. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Titanium from Secondary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	2.401E-01	2.125E-01	7.167E-03	7.304E-04	5.150E-04	4.756E-04	4.822E-04	3.392E-04
35	4.777E-01	3.998E-01	2.106E-02	1.600E-03	1.273E-03	8.940E-04	1.166E-03	9.911E-04
40	1.720E+00	7.536E-01	4.443E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	5.538E+00	1.266E+00	6.713E-02	5.213E-03	4.569E-03	2.476E-03	2.545E-03	1.871E-03
50	1.400E+01	3.433E+00	1.030E-01	7.802E-03	7.380E-03	3.781E-03	4.223E-03	4.111E-03
55	1.170E+01	7.368E+00	1.424E-01	9.813E-03	1.009E-02	5.513E-03	4.585E-03	4.870E-03
60	9.399E+00	1.126E+01	1.956E-01	1.994E-02	1.870E-02	7.860E-03	7.463E-03	7.554E-03
65	7.012E+00	1.380E+01	2.670E-01	2.359E-02	2.125E-02	1.148E-02	1.130E-02	1.098E-02
70	6.175E+00	1.424E+01	4.125E-01	3.279E-02	3.241E-02	1.580E-02	1.423E-02	1.410E-02
75	5.371E+00	1.126E+01	6.950E-01	5.401E-02	5.009E-02	2.181E-02	2.201E-02	1.939E-02
80	4.983E+00	9.445E+00	1.043E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
85	4.459E+00	7.869E+00	1.351E+00	1.700E-01	1.574E-01	3.103E-02	0.000E+00	0.000E+00
90	4.256E+00	7.300E+00	1.727E+00	2.560E-01	2.435E-01	6.718E-02	4.308E-02	4.079E-02
95	3.829E+00	6.628E+00	2.114E+00	3.348E-01	3.251E-01	1.093E-01	6.297E-02	6.056E-02
100	3.611E+00	5.976E+00	2.517E+00	4.540E-01	4.347E-01	1.544E-01	1.056E-01	9.798E-02
110	3.374E+00	5.397E+00	3.440E+00	7.374E-01	7.081E-01	2.736E-01	2.629E-01	2.513E-01
120	3.243E+00	4.941E+00	4.505E+00	1.174E+00	1.148E+00	4.337E-01	4.150E-01	4.105E-01
130	2.732E+00	4.424E+00	5.574E+00	1.631E+00	1.586E+00	6.576E-01	6.300E-01	6.125E-01
140	2.912E+00	4.290E+00	6.825E+00	1.958E+00	1.925E+00	9.096E-01	1.047E+00	9.808E-01
150	2.988E+00	4.298E+00	8.121E+00	2.251E+00	2.230E+00	1.145E+00	1.454E+00	1.440E+00
160	2.584E+00	3.807E+00	9.475E+00	2.595E+00	2.594E+00	1.332E+00	1.790E+00	1.789E+00
170	2.641E+00	3.881E+00	1.097E+01	2.872E+00	2.893E+00	1.505E+00	2.089E+00	2.080E+00
180	2.441E+00	3.714E+00	1.258E+01	3.183E+00	3.173E+00	1.674E+00	2.320E+00	2.329E+00
190	2.472E+00	3.520E+00	1.399E+01	3.442E+00	3.431E+00	1.809E+00	2.575E+00	2.586E+00
200	2.364E+00	3.263E+00	1.566E+01	3.868E+00	3.831E+00	2.001E+00	2.881E+00	2.879E+00
300	2.187E+00	3.030E+00	3.663E+01	1.542E+01	1.468E+01	2.342E+00	0.000E+00	0.000E+00
400	2.375E+00	2.981E+00	2.772E+01	9.709E+01	1.001E+02	6.690E+01	2.695E+01	2.495E+01
500	1.987E+00	2.670E+00	2.201E+01	6.648E+01	6.797E+01	4.983E+01	1.050E+02	1.070E+02
600	1.939E+00	2.668E+00	1.985E+01	5.722E+01	5.937E+01	3.947E+01	7.482E+01	7.526E+01
700	2.361E+00	2.934E+00	1.832E+01	5.166E+01	5.442E+01	3.483E+01	6.459E+01	6.541E+01
800	2.388E+00	2.865E+00	1.770E+01	4.950E+01	5.162E+01	3.271E+01	6.094E+01	6.114E+01
900	2.224E+00	2.921E+00	1.687E+01	4.709E+01	5.020E+01	3.095E+01	5.669E+01	5.759E+01
1000	2.219E+00	2.566E+00	1.660E+01	4.596E+01	4.890E+01	2.995E+01	5.507E+01	5.659E+01
1250	2.221E+00	2.641E+00	1.550E+01	4.322E+01	4.668E+01	2.799E+01	5.265E+01	5.265E+01
1500	1.802E+00	2.338E+00	1.502E+01	4.192E+01	4.421E+01	2.623E+01	4.892E+01	4.957E+01
1750	1.771E+00	2.326E+00	1.475E+01	4.107E+01	4.395E+01	2.597E+01	4.827E+01	4.882E+01
2000	1.810E+00	2.384E+00	1.459E+01	4.074E+01	4.347E+01	2.579E+01	4.855E+01	4.915E+01
2250	1.899E+00	2.416E+00	1.433E+01	4.021E+01	4.298E+01	2.548E+01	4.845E+01	4.912E+01
2500	1.775E+00	2.322E+00	1.423E+01	4.018E+01	4.302E+01	2.552E+01	4.835E+01	4.889E+01
2750	1.714E+00	2.416E+00	1.433E+01	4.006E+01	4.260E+01	2.546E+01	4.818E+01	4.919E+01
3000	1.698E+00	2.300E+00	1.429E+01	4.032E+01	4.340E+01	2.548E+01	4.756E+01	4.876E+01

Table 64. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Vanadium from Primary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
35	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
40	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	4.664E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
50	2.426E+03	8.574E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
55	1.828E+03	1.364E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	1.522E+03	1.777E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
65	1.330E+03	2.145E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
70	1.194E+03	1.710E+03	1.410E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
75	1.090E+03	1.382E+03	2.591E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
80	1.008E+03	1.205E+03	3.471E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
85	9.418E+02	1.086E+03	4.226E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
90	8.839E+02	9.932E+02	4.912E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
95	8.369E+02	9.223E+02	5.539E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
100	7.959E+02	8.657E+02	6.119E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
110	7.286E+02	7.749E+02	7.225E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
120	6.745E+02	7.076E+02	8.219E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
130	6.290E+02	6.550E+02	9.144E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
140	5.926E+02	6.127E+02	1.005E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
150	5.616E+02	5.769E+02	1.089E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
160	5.116E+02	5.204E+02	1.244E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
170	4.906E+02	4.974E+02	1.313E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
180	4.715E+02	4.776E+02	1.385E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
190	4.715E+02	4.776E+02	1.385E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
200	4.549E+02	4.605E+02	1.450E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
300	3.533E+02	3.538E+02	1.924E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
400	3.031E+02	3.026E+02	1.554E+02	2.727E+02	2.782E+02	1.095E+02	0.000E+00	0.000E+00
500	2.744E+02	2.731E+02	1.259E+02	1.737E+02	1.731E+02	9.906E+01	1.741E+02	1.769E+02
600	2.558E+02	2.547E+02	1.124E+02	1.438E+02	1.429E+02	7.351E+01	1.098E+02	1.090E+02
700	2.434E+02	2.419E+02	1.041E+02	1.291E+02	1.281E+02	6.357E+01	9.150E+01	9.061E+01
800	2.339E+02	2.327E+02	9.845E+01	1.184E+02	1.173E+02	5.716E+01	8.071E+01	7.965E+01
900	2.274E+02	2.262E+02	9.458E+01	1.133E+02	1.123E+02	5.398E+01	7.547E+01	7.444E+01
1000	2.222E+02	2.206E+02	9.146E+01	1.081E+02	1.071E+02	5.122E+01	7.108E+01	7.023E+01
1250	2.140E+02	2.128E+02	8.719E+01	1.016E+02	1.007E+02	4.732E+01	6.548E+01	6.441E+01
1500	2.105E+02	2.089E+02	8.481E+01	9.843E+01	9.750E+01	4.578E+01	6.328E+01	6.231E+01
1750	2.089E+02	2.074E+02	8.413E+01	9.846E+01	9.731E+01	4.548E+01	6.297E+01	6.216E+01
2000	2.076E+02	2.062E+02	8.372E+01	9.791E+01	9.686E+01	4.529E+01	6.275E+01	6.193E+01
2250	2.073E+02	2.060E+02	8.359E+01	9.807E+01	9.697E+01	4.525E+01	6.281E+01	6.177E+01
2500	2.082E+02	2.065E+02	8.355E+01	9.844E+01	9.744E+01	4.531E+01	6.296E+01	6.205E+01
2750	2.087E+02	2.069E+02	8.369E+01	9.844E+01	9.746E+01	4.512E+01	6.263E+01	6.178E+01
3000	2.099E+02	2.081E+02	8.359E+01	9.814E+01	9.712E+01	4.505E+01	6.286E+01	6.197E+01

Table 65. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Vanadium from Secondary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	2.452E-01	1.872E-01	7.481E-03	6.665E-04	4.667E-04	4.210E-04	1.799E-04	2.814E-04
35	5.376E-01	4.298E-01	2.253E-02	2.468E-03	1.707E-03	1.066E-03	1.349E-03	1.094E-03
40	1.574E+00	7.703E-01	4.528E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	5.738E+00	1.310E+00	7.544E-02	5.308E-03	4.575E-03	3.194E-03	4.020E-03	3.298E-03
50	1.528E+01	3.262E+00	1.063E-01	7.753E-03	6.613E-03	4.359E-03	4.729E-03	3.394E-03
55	1.333E+01	7.312E+00	1.444E-01	1.294E-02	1.135E-02	5.720E-03	5.412E-03	5.502E-03
60	1.045E+01	1.170E+01	2.036E-01	2.191E-02	2.149E-02	8.963E-03	9.690E-03	8.163E-03
65	8.501E+00	1.529E+01	2.814E-01	2.968E-02	2.784E-02	1.304E-02	1.258E-02	1.227E-02
70	6.941E+00	1.645E+01	4.108E-01	3.895E-02	3.597E-02	1.774E-02	1.595E-02	1.520E-02
75	6.056E+00	1.348E+01	6.541E-01	5.232E-02	5.382E-02	2.389E-02	2.255E-02	2.567E-02
80	5.488E+00	1.092E+01	1.047E+00	9.907E-02	8.750E-02	3.134E-02	3.124E-02	3.037E-02
85	4.992E+00	8.933E+00	1.398E+00	1.730E-01	1.601E-01	4.348E-02	3.960E-02	3.774E-02
90	4.660E+00	8.176E+00	1.794E+00	2.647E-01	2.533E-01	7.063E-02	4.499E-02	4.457E-02
95	4.498E+00	7.659E+00	2.171E+00	3.443E-01	3.353E-01	1.119E-01	6.383E-02	6.097E-02
100	4.055E+00	6.865E+00	2.652E+00	4.725E-01	4.433E-01	1.557E-01	9.677E-02	9.595E-02
110	3.612E+00	5.930E+00	3.615E+00	7.398E-01	7.104E-01	2.732E-01	2.587E-01	2.488E-01
120	3.428E+00	5.473E+00	4.741E+00	1.178E+00	1.159E+00	4.357E-01	4.389E-01	4.345E-01
130	3.347E+00	5.278E+00	6.000E+00	1.730E+00	1.713E+00	6.970E-01	6.641E-01	6.493E-01
140	3.102E+00	4.810E+00	7.292E+00	1.925E+00	1.912E+00	9.132E-01	9.987E-01	9.791E-01
150	3.140E+00	4.583E+00	8.598E+00	2.314E+00	2.308E+00	1.153E+00	1.475E+00	1.442E+00
160	2.739E+00	4.175E+00	1.160E+01	2.922E+00	2.898E+00	1.519E+00	2.109E+00	2.090E+00
170	2.815E+00	4.002E+00	1.339E+01	3.269E+00	3.247E+00	1.707E+00	2.479E+00	2.455E+00
180	2.874E+00	4.081E+00	1.520E+01	3.520E+00	3.499E+00	1.837E+00	2.654E+00	2.639E+00
190	2.874E+00	4.081E+00	1.520E+01	3.520E+00	3.499E+00	1.837E+00	2.654E+00	2.639E+00
200	2.668E+00	3.684E+00	1.691E+01	3.789E+00	3.754E+00	1.995E+00	2.953E+00	2.932E+00
300	2.558E+00	3.262E+00	3.992E+01	1.266E+01	1.227E+01	2.166E+00	0.000E+00	0.000E+00
400	2.525E+00	3.177E+00	3.243E+01	1.186E+02	1.227E+02	6.862E+01	2.156E+01	2.036E+01
500	2.201E+00	3.088E+00	2.584E+01	7.791E+01	7.934E+01	5.964E+01	1.301E+02	1.336E+02
600	2.006E+00	2.630E+00	2.298E+01	6.654E+01	6.855E+01	4.594E+01	8.757E+01	8.803E+01
700	2.403E+00	3.216E+00	2.132E+01	6.004E+01	6.256E+01	4.038E+01	7.492E+01	7.592E+01
800	2.346E+00	3.012E+00	2.034E+01	5.734E+01	5.975E+01	3.780E+01	7.051E+01	7.040E+01
900	2.295E+00	3.034E+00	1.957E+01	5.407E+01	5.723E+01	3.543E+01	6.494E+01	6.576E+01
1000	2.661E+00	3.051E+00	1.933E+01	5.325E+01	5.634E+01	3.465E+01	6.382E+01	6.480E+01
1250	2.477E+00	2.998E+00	1.798E+01	4.975E+01	5.272E+01	3.212E+01	5.870E+01	5.981E+01
1500	1.958E+00	2.595E+00	1.745E+01	4.811E+01	5.052E+01	3.008E+01	5.505E+01	5.645E+01
1750	1.800E+00	2.558E+00	1.699E+01	4.723E+01	5.011E+01	2.980E+01	5.537E+01	5.521E+01
2000	1.779E+00	2.422E+00	1.651E+01	4.612E+01	4.936E+01	2.913E+01	5.393E+01	5.501E+01
2250	1.875E+00	2.350E+00	1.654E+01	4.608E+01	4.908E+01	2.923E+01	5.486E+01	5.550E+01
2500	1.877E+00	2.586E+00	1.650E+01	4.588E+01	4.913E+01	2.912E+01	5.613E+01	5.547E+01
2750	1.862E+00	2.426E+00	1.640E+01	4.579E+01	4.902E+01	2.908E+01	5.454E+01	5.555E+01
3000	1.879E+00	2.481E+00	1.659E+01	4.626E+01	4.921E+01	2.925E+01	5.485E+01	5.555E+01

Table 66. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Chromium from Primary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
35	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
40	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	3.333E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
50	3.008E+03	6.610E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
55	2.122E+03	1.249E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	1.731E+03	1.697E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
65	1.495E+03	2.092E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
70	1.330E+03	2.207E+03	4.381E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
75	1.209E+03	1.618E+03	2.124E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
80	1.115E+03	1.373E+03	3.150E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
85	1.040E+03	1.222E+03	3.990E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
90	9.359E+02	1.051E+03	5.196E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
95	9.213E+02	1.027E+03	5.395E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
100	8.751E+02	9.608E+02	6.029E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
110	7.972E+02	8.555E+02	7.175E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
120	7.376E+02	7.792E+02	8.242E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
130	6.884E+02	7.194E+02	9.217E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
140	6.484E+02	6.718E+02	1.015E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
150	6.142E+02	6.313E+02	1.103E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
160	5.838E+02	5.973E+02	1.189E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
170	5.580E+02	5.688E+02	1.267E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
180	5.351E+02	5.443E+02	1.341E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
190	5.145E+02	5.213E+02	1.411E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
200	4.970E+02	5.025E+02	1.483E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
300	3.850E+02	3.859E+02	2.004E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
400	3.305E+02	3.299E+02	1.734E+02	3.392E+02	3.532E+02	8.807E+01	0.000E+00	0.000E+00
500	2.991E+02	2.980E+02	1.391E+02	1.967E+02	1.962E+02	1.189E+02	2.397E+02	2.509E+02
600	2.789E+02	2.778E+02	1.232E+02	1.598E+02	1.588E+02	8.287E+01	1.261E+02	1.256E+02
700	2.605E+02	2.589E+02	1.107E+02	1.353E+02	1.343E+02	6.638E+01	9.544E+01	9.429E+01
800	2.544E+02	2.532E+02	1.072E+02	1.302E+02	1.291E+02	6.313E+01	8.963E+01	8.862E+01
900	2.476E+02	2.463E+02	1.028E+02	1.227E+02	1.217E+02	5.860E+01	8.230E+01	8.132E+01
1000	2.420E+02	2.403E+02	9.943E+01	1.176E+02	1.162E+02	5.554E+01	7.746E+01	7.647E+01
1250	2.334E+02	2.319E+02	9.474E+01	1.106E+02	1.096E+02	5.173E+01	7.155E+01	7.039E+01
1500	2.292E+02	2.278E+02	9.251E+01	1.074E+02	1.063E+02	4.959E+01	6.820E+01	6.729E+01
1750	2.271E+02	2.259E+02	9.109E+01	1.059E+02	1.048E+02	4.901E+01	6.794E+01	6.705E+01
2000	2.258E+02	2.244E+02	9.089E+01	1.063E+02	1.051E+02	4.908E+01	6.783E+01	6.691E+01
2250	2.255E+02	2.242E+02	9.062E+01	1.060E+02	1.048E+02	4.902E+01	6.805E+01	6.712E+01
2500	2.266E+02	2.246E+02	9.091E+01	1.067E+02	1.056E+02	4.913E+01	6.853E+01	6.759E+01
2750	2.272E+02	2.253E+02	9.069E+01	1.063E+02	1.052E+02	4.899E+01	6.838E+01	6.754E+01
3000	2.287E+02	2.266E+02	9.137E+01	1.072E+02	1.060E+02	4.924E+01	6.870E+01	6.771E+01

Table 67. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Chromium from Secondary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	2.188E-01	1.940E-01	7.146E-03	8.560E-04	7.890E-04	4.609E-04	4.340E-04	3.954E-04
35	5.400E-01	3.984E-01	2.154E-02	1.733E-03	1.397E-03	1.011E-03	1.167E-03	9.358E-04
40	1.130E+00	6.462E-01	4.111E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	4.813E+00	1.116E+00	7.206E-02	4.851E-03	4.702E-03	2.734E-03	3.585E-03	2.119E-03
50	1.573E+01	2.606E+00	1.069E-01	7.778E-03	7.091E-03	4.050E-03	5.240E-03	3.739E-03
55	1.520E+01	6.651E+00	1.418E-01	1.177E-02	1.010E-02	5.541E-03	5.444E-03	4.876E-03
60	1.128E+01	1.127E+01	1.949E-01	2.134E-02	1.939E-02	8.166E-03	7.797E-03	7.273E-03
65	9.271E+00	1.499E+01	2.618E-01	2.825E-02	2.611E-02	1.193E-02	1.086E-02	1.015E-02
70	7.942E+00	1.755E+01	3.688E-01	3.511E-02	3.440E-02	1.611E-02	1.468E-02	1.437E-02
75	6.770E+00	1.625E+01	5.534E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
80	5.908E+00	1.195E+01	9.117E-01	9.823E-02	8.015E-02	2.843E-02	3.536E-02	3.271E-02
85	5.522E+00	1.023E+01	1.296E+00	1.689E-01	1.594E-01	4.356E-02	3.510E-02	3.643E-02
90	4.759E+00	8.253E+00	1.923E+00	3.091E-01	2.911E-01	8.719E-02	5.192E-02	5.569E-02
95	4.817E+00	8.270E+00	2.044E+00	3.388E-01	3.254E-01	1.029E-01	5.676E-02	5.605E-02
100	4.571E+00	7.381E+00	2.460E+00	4.554E-01	4.330E-01	1.534E-01	9.403E-02	9.201E-02
110	4.071E+00	6.642E+00	3.496E+00	7.697E-01	7.342E-01	2.800E-01	2.621E-01	2.531E-01
120	3.534E+00	5.903E+00	4.474E+00	1.122E+00	1.096E+00	4.245E-01	4.176E-01	4.133E-01
130	3.899E+00	5.581E+00	5.672E+00	1.634E+00	1.591E+00	6.495E-01	6.177E-01	5.945E-01
140	3.494E+00	5.310E+00	6.942E+00	1.972E+00	1.935E+00	9.025E-01	9.749E-01	9.655E-01
150	3.200E+00	4.907E+00	8.272E+00	2.291E+00	2.265E+00	1.149E+00	1.437E+00	1.421E+00
160	3.212E+00	4.856E+00	9.670E+00	2.540E+00	2.519E+00	1.301E+00	1.752E+00	1.763E+00
170	3.313E+00	4.724E+00	1.127E+01	2.805E+00	2.801E+00	1.472E+00	2.046E+00	2.045E+00
180	2.800E+00	4.196E+00	1.306E+01	3.194E+00	3.183E+00	1.685E+00	2.380E+00	2.359E+00
190	2.997E+00	4.442E+00	1.483E+01	3.588E+00	3.562E+00	1.881E+00	2.731E+00	2.692E+00
200	2.895E+00	4.115E+00	1.654E+01	3.816E+00	3.821E+00	2.016E+00	2.956E+00	2.924E+00
300	2.457E+00	3.510E+00	3.948E+01	1.183E+01	1.122E+01	4.536E+00	6.021E+00	6.011E+00
400	2.464E+00	3.379E+00	3.602E+01	1.404E+02	1.472E+02	6.126E+01	1.901E+01	1.774E+01
500	2.308E+00	3.090E+00	2.731E+01	8.349E+01	8.509E+01	6.711E+01	1.596E+02	1.677E+02
600	2.051E+00	2.921E+00	2.436E+01	7.062E+01	7.308E+01	4.906E+01	9.441E+01	9.497E+01
700	2.518E+00	3.241E+00	2.237E+01	6.294E+01	6.579E+01	4.189E+01	7.714E+01	7.815E+01
800	2.282E+00	3.021E+00	2.160E+01	6.022E+01	6.284E+01	3.984E+01	7.390E+01	7.466E+01
900	2.310E+00	3.044E+00	2.081E+01	5.814E+01	6.114E+01	3.802E+01	7.008E+01	7.046E+01
1000	2.483E+00	3.298E+00	2.023E+01	5.601E+01	5.851E+01	3.647E+01	6.696E+01	6.794E+01
1250	2.487E+00	3.120E+00	1.934E+01	5.313E+01	5.633E+01	3.421E+01	6.342E+01	6.415E+01
1500	2.073E+00	2.592E+00	1.847E+01	5.109E+01	5.413E+01	3.228E+01	5.960E+01	6.083E+01
1750	1.968E+00	2.654E+00	1.815E+01	5.014E+01	5.323E+01	3.151E+01	5.904E+01	5.883E+01
2000	2.093E+00	2.772E+00	1.775E+01	4.898E+01	5.230E+01	3.099E+01	5.727E+01	5.854E+01
2250	1.933E+00	2.612E+00	1.772E+01	4.916E+01	5.218E+01	3.093E+01	5.762E+01	5.839E+01
2500	1.842E+00	2.544E+00	1.751E+01	4.887E+01	5.166E+01	3.109E+01	5.870E+01	5.873E+01
2750	1.973E+00	2.613E+00	1.759E+01	4.908E+01	5.205E+01	3.092E+01	5.794E+01	5.861E+01
3000	1.901E+00	2.750E+00	1.748E+01	4.888E+01	5.234E+01	3.093E+01	5.769E+01	5.864E+01

Table 68. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Manganese from Primary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
35	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
40	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	2.829E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
50	3.472E+03	5.971E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
55	2.367E+03	1.256E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	1.908E+03	1.744E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
65	1.641E+03	2.170E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
70	1.459E+03	2.552E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
75	1.322E+03	1.813E+03	1.995E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
80	1.216E+03	1.522E+03	3.151E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
85	1.134E+03	1.347E+03	4.066E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
90	1.062E+03	1.221E+03	4.875E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
95	1.003E+03	1.125E+03	5.593E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
100	9.532E+02	1.049E+03	6.275E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
110	8.686E+02	9.347E+02	7.510E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
120	8.021E+02	8.495E+02	8.634E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
130	7.485E+02	7.837E+02	9.697E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
140	7.043E+02	7.307E+02	1.067E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
150	6.659E+02	6.866E+02	1.162E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
160	6.344E+02	6.494E+02	1.251E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
170	6.053E+02	6.177E+02	1.332E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
180	5.815E+02	5.916E+02	1.413E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
190	5.585E+02	5.679E+02	1.489E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
200	5.388E+02	5.452E+02	1.565E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
300	4.178E+02	4.179E+02	2.114E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
400	3.585E+02	3.580E+02	1.896E+02	3.930E+02	4.151E+02	7.977E+01	0.000E+00	0.000E+00
500	3.239E+02	3.224E+02	1.494E+02	2.100E+02	2.099E+02	1.309E+02	2.906E+02	3.165E+02
600	3.021E+02	3.005E+02	1.320E+02	1.696E+02	1.686E+02	8.764E+01	1.342E+02	1.336E+02
700	2.873E+02	2.856E+02	1.222E+02	1.506E+02	1.493E+02	7.425E+01	1.071E+02	1.060E+02
800	2.759E+02	2.746E+02	1.151E+02	1.383E+02	1.368E+02	6.675E+01	9.466E+01	9.363E+01
900	2.691E+02	2.669E+02	1.105E+02	1.304E+02	1.291E+02	6.195E+01	8.614E+01	8.520E+01
1000	2.624E+02	2.609E+02	1.069E+02	1.247E+02	1.235E+02	5.890E+01	8.185E+01	8.096E+01
1250	2.533E+02	2.517E+02	1.015E+02	1.168E+02	1.156E+02	5.426E+01	7.443E+01	7.349E+01
1500	2.488E+02	2.470E+02	9.940E+01	1.143E+02	1.132E+02	5.306E+01	7.297E+01	7.195E+01
1750	2.467E+02	2.445E+02	9.800E+01	1.126E+02	1.115E+02	5.209E+01	7.182E+01	7.083E+01
2000	2.453E+02	2.435E+02	9.745E+01	1.120E+02	1.108E+02	5.169E+01	7.149E+01	7.051E+01
2250	2.451E+02	2.430E+02	9.747E+01	1.125E+02	1.114E+02	5.174E+01	7.139E+01	7.043E+01
2500	2.454E+02	2.437E+02	9.743E+01	1.131E+02	1.118E+02	5.176E+01	7.151E+01	7.062E+01
2750	2.467E+02	2.446E+02	9.755E+01	1.135E+02	1.122E+02	5.192E+01	7.194E+01	7.099E+01
3000	2.477E+02	2.459E+02	9.804E+01	1.140E+02	1.128E+02	5.223E+01	7.252E+01	7.138E+01

Table 69. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Manganese from Secondary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	2.280E-01	1.791E-01	7.607E-03	8.557E-04	7.512E-04	4.438E-04	6.621E-04	8.495E-05
35	6.161E-01	3.987E-01	2.172E-02	1.752E-03	8.314E-04	9.762E-04	1.041E-03	1.320E-03
40	1.295E+00	7.133E-01	4.528E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	4.771E+00	1.119E+00	7.772E-02	7.544E-03	6.138E-03	3.035E-03	1.967E-03	2.046E-03
50	1.562E+01	2.364E+00	1.077E-01	9.663E-03	7.867E-03	3.705E-03	0.000E+00	0.000E+00
55	1.822E+01	6.545E+00	1.433E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	1.323E+01	1.159E+01	2.044E-01	2.317E-02	2.429E-02	9.407E-03	8.558E-03	8.689E-03
65	1.075E+01	1.567E+01	2.612E-01	3.089E-02	2.785E-02	1.362E-02	1.511E-02	1.207E-02
70	9.157E+00	1.939E+01	3.648E-01	4.272E-02	3.743E-02	1.850E-02	1.635E-02	1.577E-02
75	7.648E+00	1.822E+01	5.460E-01	5.406E-02	5.119E-02	2.452E-02	2.656E-02	2.488E-02
80	6.507E+00	1.370E+01	8.998E-01	1.041E-01	9.639E-02	3.366E-02	3.371E-02	3.254E-02
85	6.102E+00	1.152E+01	1.282E+00	1.866E-01	1.688E-01	4.648E-02	4.200E-02	4.141E-02
90	5.895E+00	1.057E+01	1.597E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
95	5.485E+00	9.484E+00	2.108E+00	3.631E-01	3.492E-01	1.126E-01	6.486E-02	6.315E-02
100	4.865E+00	8.470E+00	2.532E+00	4.753E-01	4.629E-01	1.669E-01	1.039E-01	1.011E-01
110	4.627E+00	7.522E+00	3.557E+00	7.459E-01	7.272E-01	2.822E-01	2.731E-01	2.608E-01
120	3.975E+00	6.620E+00	4.704E+00	1.161E+00	1.149E+00	4.471E-01	4.490E-01	4.357E-01
130	3.891E+00	5.968E+00	5.904E+00	1.633E+00	1.605E+00	6.573E-01	6.465E-01	6.203E-01
140	3.527E+00	5.798E+00	7.316E+00	1.991E+00	1.963E+00	9.332E-01	1.017E+00	9.995E-01
150	3.648E+00	5.797E+00	8.740E+00	2.241E+00	2.240E+00	1.138E+00	1.444E+00	1.420E+00
160	3.649E+00	5.080E+00	1.029E+01	2.534E+00	2.513E+00	1.310E+00	1.772E+00	1.783E+00
170	3.393E+00	4.850E+00	1.106E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
180	3.307E+00	4.925E+00	1.387E+01	3.201E+00	3.214E+00	1.706E+00	2.432E+00	2.429E+00
190	2.985E+00	4.348E+00	1.580E+01	3.573E+00	3.542E+00	1.873E+00	2.730E+00	2.668E+00
200	3.076E+00	4.603E+00	1.770E+01	3.712E+00	3.751E+00	1.989E+00	2.979E+00	2.924E+00
300	2.800E+00	3.712E+00	4.266E+01	1.089E+01	1.052E+01	1.919E+00	0.000E+00	0.000E+00
400	2.721E+00	3.498E+00	4.248E+01	1.764E+02	1.882E+02	5.864E+01	1.633E+01	1.567E+01
500	2.661E+00	3.436E+00	3.218E+01	9.870E+01	1.006E+02	8.306E+01	2.212E+02	2.367E+02
600	2.605E+00	3.376E+00	2.832E+01	8.195E+01	8.360E+01	5.730E+01	1.112E+02	1.115E+02
700	2.456E+00	3.367E+00	2.602E+01	7.381E+01	7.603E+01	4.954E+01	9.305E+01	9.305E+01
800	2.809E+00	3.737E+00	2.491E+01	6.928E+01	7.242E+01	4.566E+01	8.416E+01	8.462E+01
900	2.554E+00	3.538E+00	2.401E+01	6.634E+01	6.940E+01	4.343E+01	7.984E+01	8.033E+01
1000	2.446E+00	3.289E+00	2.318E+01	6.402E+01	6.761E+01	4.145E+01	7.584E+01	7.657E+01
1250	2.617E+00	3.177E+00	2.207E+01	6.080E+01	6.399E+01	3.892E+01	7.088E+01	7.203E+01
1500	1.847E+00	2.669E+00	2.115E+01	5.843E+01	6.154E+01	3.713E+01	7.059E+01	6.908E+01
1750	1.977E+00	2.718E+00	2.079E+01	5.732E+01	6.023E+01	3.575E+01	6.607E+01	6.610E+01
2000	2.123E+00	2.805E+00	2.050E+01	5.690E+01	6.004E+01	3.558E+01	6.570E+01	6.606E+01
2250	2.007E+00	2.799E+00	2.019E+01	5.591E+01	5.960E+01	3.526E+01	6.561E+01	6.600E+01
2500	2.294E+00	3.001E+00	2.014E+01	5.561E+01	5.883E+01	3.513E+01	6.507E+01	6.637E+01
2750	1.980E+00	2.676E+00	2.016E+01	5.570E+01	5.889E+01	3.525E+01	6.530E+01	6.670E+01
3000	2.040E+00	2.816E+00	1.994E+01	5.517E+01	5.833E+01	3.494E+01	6.639E+01	6.673E+01

Table 70. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Iron from Primary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
35	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
40	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
50	4.687E+03	2.737E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
55	2.776E+03	1.102E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
60	2.163E+03	1.642E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
65	1.838E+03	2.095E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
70	1.616E+03	2.505E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
75	1.460E+03	2.184E+03	1.259E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
80	1.340E+03	1.743E+03	2.718E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
85	1.242E+03	1.513E+03	3.748E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
90	1.162E+03	1.358E+03	4.619E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
95	1.095E+03	1.246E+03	5.411E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
100	1.041E+03	1.159E+03	6.136E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
110	9.479E+02	1.026E+03	7.441E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
120	8.738E+02	9.297E+02	8.621E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
130	8.148E+02	8.554E+02	9.731E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
140	7.641E+02	7.957E+02	1.074E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
150	7.227E+02	7.476E+02	1.173E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
160	6.881E+02	7.075E+02	1.266E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
170	6.570E+02	6.718E+02	1.353E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
180	6.291E+02	6.411E+02	1.440E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
190	6.059E+02	6.169E+02	1.519E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
200	5.848E+02	5.928E+02	1.594E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
300	4.516E+02	4.532E+02	2.184E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
400	3.878E+02	3.872E+02	2.149E+02	5.872E+02	7.085E+02	3.660E+01	0.000E+00	0.000E+00
500	3.507E+02	3.497E+02	1.640E+02	2.363E+02	2.366E+02	1.841E+02	0.000E+00	0.000E+00
600	3.272E+02	3.257E+02	1.441E+02	1.873E+02	1.864E+02	9.912E+01	1.554E+02	1.554E+02
700	3.106E+02	3.084E+02	1.324E+02	1.640E+02	1.627E+02	8.181E+01	1.197E+02	1.187E+02
800	2.988E+02	2.974E+02	1.249E+02	1.504E+02	1.490E+02	7.290E+01	1.041E+02	1.029E+02
900	2.906E+02	2.884E+02	1.196E+02	1.410E+02	1.396E+02	6.716E+01	9.377E+01	9.247E+01
1000	2.841E+02	2.823E+02	1.159E+02	1.355E+02	1.342E+02	6.412E+01	8.923E+01	8.807E+01
1250	2.737E+02	2.720E+02	1.103E+02	1.275E+02	1.260E+02	5.945E+01	8.197E+01	8.095E+01
1500	2.688E+02	2.667E+02	1.069E+02	1.221E+02	1.209E+02	5.654E+01	7.807E+01	7.706E+01
1750	2.669E+02	2.645E+02	1.060E+02	1.219E+02	1.206E+02	5.613E+01	7.680E+01	7.583E+01
2000	2.654E+02	2.636E+02	1.055E+02	1.216E+02	1.204E+02	5.601E+01	7.713E+01	7.602E+01
2250	2.651E+02	2.627E+02	1.052E+02	1.218E+02	1.204E+02	5.588E+01	7.690E+01	7.588E+01
2500	2.656E+02	2.637E+02	1.051E+02	1.215E+02	1.200E+02	5.568E+01	7.697E+01	7.586E+01
2750	2.667E+02	2.643E+02	1.054E+02	1.217E+02	1.205E+02	5.581E+01	7.719E+01	7.619E+01
3000	2.685E+02	2.659E+02	1.058E+02	1.224E+02	1.211E+02	5.589E+01	7.778E+01	7.667E+01

Table 71. Incoming Ion Energy (MeV/n) vs. LET (keV/micron) for Iron from Secondary Particle Contribution

	LET							
Energy	Detector 1	Detector 2	TEP 1	Detector 3	Detector 4	TEP 2	Detector 5	Detector 6
20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
30	2.556E-01	1.979E-01	7.660E-03	9.357E-04	4.877E-04	3.719E-04	2.366E-04	2.050E-04
35	5.046E-01	3.724E-01	2.049E-02	1.489E-03	1.078E-03	7.557E-04	8.020E-04	9.294E-04
40	1.281E+00	6.767E-01	4.425E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
45	3.308E+00	1.014E+00	7.183E-02	5.414E-03	4.106E-03	2.599E-03	2.887E-03	2.110E-03
50	1.281E+01	2.145E+00	1.054E-01	8.338E-03	7.649E-03	3.836E-03	3.497E-03	2.789E-03
55	2.082E+01	5.816E+00	1.486E-01	1.304E-02	1.122E-02	5.483E-03	5.889E-03	5.468E-03
60	1.542E+01	1.136E+01	1.971E-01	2.253E-02	2.043E-02	8.826E-03	7.921E-03	7.520E-03
65	1.119E+01	1.431E+01	2.554E-01	3.130E-02	2.699E-02	1.305E-02	1.061E-02	1.049E-02
70	9.866E+00	1.924E+01	3.498E-01	4.165E-02	3.764E-02	1.773E-02	1.677E-02	1.392E-02
75	7.808E+00	1.945E+01	4.946E-01	5.554E-02	5.270E-02	2.179E-02	2.193E-02	2.166E-02
80	6.692E+00	1.559E+01	7.596E-01	9.508E-02	8.761E-02	2.929E-02	2.670E-02	2.692E-02
85	6.730E+00	1.293E+01	1.208E+00	1.837E-01	1.688E-01	4.508E-02	3.928E-02	3.799E-02
90	6.424E+00	1.169E+01	1.608E+00	2.840E-01	2.658E-01	7.277E-02	4.969E-02	5.029E-02
95	6.196E+00	1.049E+01	1.972E+00	3.439E-01	3.331E-01	1.061E-01	6.151E-02	6.309E-02
100	4.993E+00	8.737E+00	2.372E+00	4.666E-01	4.494E-01	1.301E-01	0.000E+00	0.000E+00
110	4.361E+00	7.298E+00	3.346E+00	7.306E-01	7.044E-01	2.656E-01	2.378E-01	2.302E-01
120	4.333E+00	7.303E+00	4.436E+00	1.084E+00	1.066E+00	0.000E+00	0.000E+00	0.000E+00
130	4.325E+00	7.004E+00	5.680E+00	1.548E+00	1.505E+00	6.216E-01	6.017E-01	5.936E-01
140	4.040E+00	6.140E+00	7.034E+00	1.948E+00	1.915E+00	5.283E-01	0.000E+00	0.000E+00
150	3.740E+00	5.660E+00	8.528E+00	2.291E+00	2.287E+00	1.151E+00	1.423E+00	1.406E+00
160	3.699E+00	5.473E+00	9.860E+00	2.529E+00	2.513E+00	1.308E+00	1.797E+00	1.747E+00
170	3.550E+00	5.382E+00	1.173E+01	2.885E+00	2.897E+00	1.503E+00	2.099E+00	2.073E+00
180	3.633E+00	5.481E+00	1.336E+01	3.156E+00	3.137E+00	1.663E+00	2.356E+00	2.359E+00
190	3.122E+00	4.606E+00	1.512E+01	3.459E+00	3.462E+00	1.841E+00	2.667E+00	2.657E+00
200	2.955E+00	4.496E+00	1.746E+01	3.770E+00	3.776E+00	2.023E+00	2.953E+00	2.957E+00
300	2.886E+00	4.161E+00	4.163E+01	1.031E+01	1.016E+01	4.363E+00	6.047E+00	6.016E+00
400	2.662E+00	3.651E+00	4.741E+01	2.331E+02	2.645E+02	4.505E+01	1.495E+01	1.478E+01
500	2.576E+00	3.592E+00	3.378E+01	1.061E+02	1.082E+02	9.963E+01	2.510E+02	2.203E+02
600	2.379E+00	3.236E+00	2.996E+01	8.761E+01	8.925E+01	6.177E+01	1.218E+02	1.230E+02
700	2.810E+00	3.732E+00	2.781E+01	7.895E+01	8.131E+01	5.289E+01	9.906E+01	9.919E+01
800	2.653E+00	3.667E+00	2.628E+01	7.329E+01	7.593E+01	4.843E+01	8.946E+01	8.956E+01
900	2.656E+00	3.512E+00	2.521E+01	7.022E+01	7.331E+01	4.587E+01	8.412E+01	8.513E+01
1000	2.632E+00	3.504E+00	2.459E+01	6.765E+01	7.118E+01	4.381E+01	8.122E+01	8.124E+01
1250	2.850E+00	3.596E+00	2.325E+01	6.385E+01	6.696E+01	4.102E+01	7.576E+01	7.614E+01
1500	2.096E+00	2.909E+00	2.258E+01	6.238E+01	6.617E+01	3.960E+01	7.287E+01	7.388E+01
1750	1.962E+00	2.962E+00	2.190E+01	6.040E+01	6.328E+01	3.783E+01	6.887E+01	7.022E+01
2000	2.073E+00	2.946E+00	2.149E+01	5.926E+01	6.237E+01	3.732E+01	6.915E+01	6.927E+01
2250	2.309E+00	2.904E+00	2.140E+01	5.888E+01	6.203E+01	3.711E+01	6.853E+01	6.942E+01
2500	1.996E+00	2.796E+00	2.128E+01	5.906E+01	6.223E+01	3.726E+01	6.917E+01	6.971E+01
2750	2.256E+00	2.914E+00	2.116E+01	5.903E+01	6.232E+01	3.725E+01	6.970E+01	6.991E+01
3000	1.940E+00	2.804E+00	2.115E+01	5.905E+01	6.237E+01	3.716E+01	6.989E+01	7.048E+01

Table 72. LET Lookup tables for Primary Particles in Detector 1 using equation y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9 (The lower case column headers are the equation coefficients)

Atomic No.	a	b	c	d	e	f	g	h	i	j	k	DoF adj. r2
1	3.695E-01	4.513E+01	2.036E+04	-2.998E+06	2.314E+08	-1.013E+10	2.522E+11	-3.314E+12	1.780E+13	0.000E+00	0.000E+00	0.999983
2	1.487E+00	1.993E+02	7.677E+04	-1.164E+07	9.160E+08	-4.064E+10	1.021E+12	-1.350E+13	7.276E+13	0.000E+00	0.000E+00	0.999979
3	3.324E+00	3.967E+02	1.799E+05	-2.622E+07	2.012E+09	-8.764E+10	2.170E+12	-2.834E+13	1.511E+14	0.000E+00	0.000E+00	0.999980
4	6.176E+00	2.492E+01	7.848E+05	-1.792E+08	2.336E+10	-1.874E+12	9.528E+13	-3.067E+15	6.036E+16	-6.607E+17	3.073E+18	0.999995
5	9.765E+00	-3.391E+02	1.593E+06	-4.193E+08	6.344E+10	-5.910E+12	3.492E+14	-1.308E+16	3.002E+17	-3.844E+18	2.100E+19	0.999995
6	1.374E+01	4.779E+02	1.430E+06	-2.900E+08	3.306E+10	-2.264E+12	9.504E+13	-2.387E+15	3.285E+16	-1.898E+17	0.000E+00	0.999993
7	1.854E+01	1.036E+03	1.669E+06	-3.083E+08	3.101E+10	-1.776E+12	5.717E+13	-9.126E+14	3.929E+15	3.779E+16	0.000E+00	0.999997
8	1.907E+01	1.103E+04	-1.774E+06	2.639E+08	-1.709E+10	4.990E+11	-5.257E+12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.998922
9	3.123E+01	-7.323E+01	4.147E+06	-9.509E+08	1.233E+11	-9.592E+12	4.569E+14	-1.299E+16	2.019E+17	-1.312E+18	0.000E+00	0.999995
10	3.951E+01	-3.270E+03	8.078E+06	-2.342E+09	3.954E+11	-4.144E+13	2.779E+15	-1.193E+17	3.173E+18	-4.761E+19	3.086E+20	0.999999
11	4.718E+01	-1.702E+03	7.563E+06	-1.910E+09	2.756E+11	-2.405E+13	1.293E+15	-4.176E+16	7.420E+17	-5.552E+18	0.000E+00	0.999997
12	5.778E+01	-7.812E+03	1.475E+07	-4.757E+09	8.999E+11	-1.060E+14	8.009E+15	-3.874E+17	1.160E+19	-1.960E+20	1.428E+21	0.999998
13	6.580E+01	-2.206E+03	1.035E+07	-2.547E+09	3.512E+11	-2.832E+13	1.340E+15	-3.516E+16	4.318E+17	-1.322E+18	0.000E+00	0.999996
14	7.886E+01	-8.415E+03	1.478E+07	-3.247E+09	3.628E+11	-2.120E+13	6.180E+14	-7.017E+15	0.000E+00	0.000E+00	0.000E+00	0.999856
15	5.825E+01	6.121E+04	-1.977E+07	3.811E+09	-3.222E+11	1.231E+13	-1.712E+14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.995377
16	1.013E+02	-8.962E+03	2.062E+07	-5.649E+09	8.644E+11	-7.678E+13	3.944E+15	-1.085E+17	1.237E+18	0.000E+00	0.000E+00	0.999997
17	1.119E+02	-1.853E+03	1.496E+07	-2.765E+09	1.534E+11	2.099E+13	-3.926E+15	2.600E+17	-8.046E+18	9.733E+19	0.000E+00	0.999995
18	1.269E+02	-7.603E+03	2.246E+07	-5.632E+09	7.628E+11	-5.561E+13	1.893E+15	-1.649E+15	-1.648E+18	3.184E+19	0.000E+00	0.999996
19	8.306E+01	1.279E+05	-5.256E+07	1.126E+10	-1.062E+12	4.536E+13	-7.085E+14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.991278
20	1.627E+02	-2.959E+04	4.734E+07	-1.496E+10	2.622E+12	-2.648E+14	1.536E+16	-4.742E+17	6.045E+18	0.000E+00	0.000E+00	0.999991
21	1.794E+02	-3.579E+04	6.077E+07	-2.360E+10	5.533E+12	-8.220E+14	7.926E+16	-4.940E+18	1.921E+20	-4.236E+21	4.051E+22	0.999999
22	1.971E+02	-3.700E+04	5.838E+07	-1.858E+10	3.276E+12	-3.328E+14	1.940E+16	-6.016E+17	7.693E+18	0.000E+00	0.000E+00	0.999992
23	2.135E+02	-3.575E+04	6.160E+07	-2.015E+10	3.592E+12	-3.603E+14	2.016E+16	-5.677E+17	5.123E+18	4.486E+19	0.000E+00	0.999957
24	1.728E+02	1.187E+05	-4.413E+07	1.109E+10	-1.178E+12	5.594E+13	-9.571E+14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.997350
25	2.690E+02	-3.024E+04	5.989E+07	-1.636E+10	2.295E+12	-1.398E+14	-1.698E+15	7.240E+17	-3.705E+19	6.297E+20	0.000E+00	0.999996
26	2.757E+02	-5.445E+04	8.638E+07	-2.907E+10	5.503E+12	-6.047E+14	3.835E+16	-1.298E+18	1.819E+19	0.000E+00	0.000E+00	0.999994

Table 73. LET Lookup tables for Secondary Particles in Detector 1 using equation y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9 (The lower case column headers are the equation coefficients)

Atomic No.	a	b	c	d	e	f	g	h	i	j	k	DoF adj. r2
1	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	NA
2	3.085E-01	7.094E+02	-5.536E+05	1.812E+08	-2.916E+10	2.243E+12	-6.577E+13	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.751353
3	2.924E+00	-2.291E+03	2.248E+06	-9.020E+08	1.797E+11	-2.029E+13	1.369E+15	-5.473E+16	1.199E+18	-1.109E+19	0.000E+00	0.933207
4	1.700E+00	2.388E+02	1.850E+05	-1.959E+08	4.962E+10	-5.824E+12	3.573E+14	-1.112E+16	1.389E+17	0.000E+00	0.000E+00	0.960458
5	1.330E+00	1.230E+03	-7.550E+05	1.638E+08	-1.830E+10	1.165E+12	-4.271E+13	8.394E+14	-6.852E+15	0.000E+00	0.000E+00	0.941365
6	1.489E+00	7.091E+02	-4.955E+05	1.067E+08	-1.145E+10	6.909E+11	-2.386E+13	4.405E+14	-3.375E+15	0.000E+00	0.000E+00	0.933966
7	1.386E+00	5.143E+02	-4.107E+05	9.423E+07	-1.051E+10	6.456E+11	-2.225E+13	4.030E+14	-2.987E+15	0.000E+00	0.000E+00	0.899717
8	1.262E+00	4.674E+02	-3.662E+05	8.497E+07	-9.609E+09	5.975E+11	-2.077E+13	3.775E+14	-2.794E+15	0.000E+00	0.000E+00	0.921549
9	1.501E+00	-2.409E+02	3.906E+04	-4.266E+06	2.779E+08	-8.447E+09	9.178E+10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.767028
10	1.197E+00	8.248E+02	-7.551E+05	2.566E+08	-4.561E+10	4.701E+12	-2.904E+14	1.060E+16	-2.106E+17	1.757E+18	0.000E+00	0.907707
11	1.294E+00	1.205E+02	-8.512E+04	1.392E+07	-9.841E+08	3.309E+10	-4.286E+11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.945162
12	1.405E+00	-1.782E+00	-4.128E+04	8.076E+06	-6.348E+08	2.410E+10	-3.541E+11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.964226
13	1.287E+00	1.969E+02	-1.713E+05	4.233E+07	-4.775E+09	2.745E+11	-7.704E+12	8.312E+13	0.000E+00	0.000E+00	0.000E+00	0.964727
14	1.221E+00	3.151E+02	-1.501E+05	2.585E+07	-2.083E+09	8.188E+10	-1.239E+12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.968967
15	1.263E+00	1.500E+02	6.114E+04	-5.871E+07	1.344E+10	-1.323E+12	4.856E+13	1.431E+15	-1.918E+17	6.355E+18	-7.347E+19	0.989645
16	1.192E+00	5.591E+02	-3.205E+05	8.268E+07	-1.250E+10	1.220E+12	-7.609E+13	2.883E+15	-5.953E+16	5.052E+17	0.000E+00	0.988126
17	1.259E+00	4.198E+02	-1.707E+05	2.764E+07	-2.124E+09	8.551E+10	-1.699E+12	1.283E+13	0.000E+00	0.000E+00	0.000E+00	0.987874
18	1.219E+00	7.928E+02	-3.687E+05	6.975E+07	-5.543E+09	1.155E+11	8.667E+12	-5.048E+14	7.372E+15	0.000E+00	0.000E+00	0.993489
19	1.103E+00	1.220E+03	-7.026E+05	1.713E+08	-2.055E+10	1.286E+12	-3.975E+13	4.764E+14	0.000E+00	0.000E+00	0.000E+00	0.9733379
20	1.337E+00	7.867E+02	-5.074E+05	1.688E+08	-3.100E+10	3.300E+12	-2.026E+14	6.808E+15	-1.057E+17	4.033E+17	0.000E+00	0.996573
21	1.049E+00	2.028E+03	-1.560E+06	5.671E+08	-1.120E+11	1.303E+13	-9.135E+14	3.783E+16	-8.470E+17	7.847E+18	0.000E+00	0.996248
22	9.730E-01	2.678E+03	-2.190E+06	8.886E+08	-2.047E+11	2.899E+13	-2.608E+15	1.493E+17	-5.263E+18	1.044E+20	-8.951E+20	0.996663
23	2.550E+00	-1.253E+03	7.792E+05	-1.584E+08	1.414E+10	-5.513E+11	7.704E+12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.921221
24	1.521E+00	1.283E+03	-5.106E+05	-6.229E+07	9.049E+10	-2.490E+13	3.423E+15	-2.686E+17	1.221E+19	-2.988E+20	3.047E+21	0.997034
25	1.044E+00	3.379E+03	-2.900E+06	1.250E+09	-2.956E+11	4.102E+13	-3.406E+15	1.660E+17	-4.362E+18	4.753E+19	0.000E+00	0.994906
26	1.241E+00	2.825E+03	-2.163E+06	8.156E+08	-1.685E+11	2.080E+13	-1.591E+15	7.704E+16	-2.404E+18	4.851E+19	-5.232E+20	0.994898

Table 74. LET Lookup tables for Primary Particles in Detector 2 using equation y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9 (The lower case column headers are the equation coefficients)

Atomic No.	a	b	c	d	e	f	g	h	i	j	k	DoF adj. r2
1	3.765E-01	2.604E+01	3.163E+04	-5.765E+06	5.791E+08	-3.463E+10	1.260E+12	-2.725E+13	3.211E+14	-1.582E+15	0.000E+00	0.999992
2	1.466E+00	1.832E+02	7.878E+04	-1.159E+07	8.920E+08	-3.891E+10	9.638E+11	-1.258E+13	6.708E+13	0.000E+00	0.000E+00	0.999983
3	3.314E+00	3.746E+02	1.913E+05	-2.877E+07	2.298E+09	-1.040E+11	2.673E+12	-3.613E+13	1.993E+14	0.000E+00	0.000E+00	0.999993
4	6.246E+00	-2.878E+02	1.056E+06	-2.774E+08	4.194E+10	-3.911E+12	2.320E+14	-8.758E+15	2.033E+17	-2.642E+18	1.469E+19	0.999998
5	1.053E+01	-6.226E+02	8.019E+05	-7.041E+07	2.515E+09	-2.975E+10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.997088
6	1.060E+01	7.041E+03	-1.830E+06	3.679E+08	-3.346E+10	1.501E+12	-3.185E+13	2.543E+14	0.000E+00	0.000E+00	0.000E+00	0.997489
7	1.944E+01	-2.037E+03	4.382E+06	-1.331E+09	2.354E+11	-2.570E+13	1.780E+15	-7.792E+16	2.077E+18	-3.053E+19	1.883E+20	0.999997
8	2.769E+01	-7.881E+03	8.125E+06	-1.896E+09	2.195E+11	-1.317E+13	3.914E+14	-4.528E+15	0.000E+00	0.000E+00	0.000E+00	0.999160
9	4.385E+01	-2.230E+04	1.117E+07	-1.543E+09	9.596E+10	-2.642E+12	2.616E+13	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.964649
10	2.323E+01	3.768E+04	-1.853E+07	4.646E+09	-5.367E+11	3.097E+13	-8.597E+14	9.115E+15	0.000E+00	0.000E+00	0.000E+00	0.985173
11	2.924E+01	3.947E+04	-1.583E+07	3.404E+09	-3.215E+11	1.372E+13	-2.137E+14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.992253
12	7.865E+01	-4.669E+04	2.676E+07	-4.462E+09	3.363E+11	-1.128E+13	1.365E+14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.977343
13	1.104E+02	-1.476E+05	1.433E+08	-5.348E+10	1.039E+13	-1.146E+15	7.427E+16	-2.787E+18	5.589E+19	-4.629E+20	0.000E+00	0.980223
14	4.356E+01	8.640E+04	-5.170E+07	1.492E+10	-1.998E+12	1.346E+14	-4.383E+15	5.470E+16	0.000E+00	0.000E+00	0.000E+00	0.992983
15	1.404E+02	-1.836E+05	1.899E+08	-7.619E+10	1.598E+13	-1.905E+15	1.331E+17	-5.382E+18	1.161E+20	-1.033E+21	0.000E+00	0.975302
16	6.628E+01	9.370E+04	-6.166E+07	2.070E+10	-3.276E+12	2.713E+14	-1.188E+16	2.569E+17	-2.128E+18	0.000E+00	0.000E+00	0.988289
17	5.705E+01	1.535E+05	-1.022E+08	3.166E+10	-4.591E+12	3.368E+14	-1.201E+16	1.646E+17	0.000E+00	0.000E+00	0.000E+00	0.990725
18	1.962E+02	-2.507E+05	2.695E+08	-1.132E+11	2.500E+13	-3.149E+15	2.333E+17	-1.001E+19	2.297E+20	-2.177E+21	0.000E+00	0.994336
19	2.131E+02	-2.703E+05	3.081E+08	-1.388E+11	3.304E+13	-4.488E+15	3.585E+17	-1.659E+19	4.105E+20	-4.194E+21	0.000E+00	0.992509
20	2.861E+01	5.287E+05	-7.078E+08	4.498E+11	-1.504E+14	2.928E+16	-3.484E+18	2.563E+20	-1.135E+22	2.772E+23	-2.861E+24	0.986305
21	2.227E+01	6.198E+05	-8.272E+08	5.222E+11	-1.736E+14	3.357E+16	-3.968E+18	2.900E+20	-1.276E+22	3.093E+23	-3.171E+24	0.982121
22	2.946E+02	-3.866E+05	4.237E+08	-1.814E+11	4.015E+13	-4.906E+15	3.331E+17	-1.173E+19	1.666E+20	0.000E+00	0.000E+00	0.987113
23	5.772E+01	6.203E+05	-8.429E+08	5.476E+11	-1.869E+14	3.706E+16	-4.486E+18	3.354E+20	-1.510E+22	3.743E+23	-3.922E+24	0.993430
24	1.537E+02	2.101E+05	-1.570E+08	5.941E+10	-1.037E+13	9.061E+14	-3.812E+16	6.111E+17	0.000E+00	0.000E+00	0.000E+00	0.982607
25	4.369E+02	-7.599E+05	9.251E+08	-4.697E+11	1.257E+14	-1.920E+16	1.724E+18	-8.981E+19	2.505E+21	-2.891E+22	0.000E+00	0.980107
26	7.545E+01	8.116E+05	-1.160E+09	7.988E+11	-2.911E+14	6.203E+16	-8.100E+18	6.555E+20	-3.199E+22	8.610E+23	-9.803E+24	0.995247

Table 75. LET Lookup tables for Secondary Particles in Detector 2 using equation y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9 (The lower case column headers are the equation coefficients)

Atomic No.	a	b	c	d	e	f	g	h	i	j	k	DoF adj. r2
1	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	NA
2	1.305E-01	1.734E+03	-1.881E+06	9.489E+08	-2.650E+11	4.395E+13	-4.441E+15	2.687E+17	-8.964E+18	1.269E+20	0.000E+00	0.950877
3	2.801E+00	-1.446E+03	1.460E+06	-5.780E+08	1.067E+11	-1.054E+13	5.772E+14	-1.657E+16	1.947E+17	0.000E+00	0.000E+00	0.929762
4	1.451E+00	1.525E+03	-8.760E+05	1.770E+08	-1.832E+10	1.077E+12	-3.638E+13	6.592E+14	-4.970E+15	0.000E+00	0.000E+00	0.949094
5	1.600E+00	9.682E+02	-6.029E+05	1.190E+08	-1.139E+10	5.780E+11	-1.496E+13	1.555E+14	0.000E+00	0.000E+00	0.000E+00	0.950146
6	1.591E+00	1.006E+03	-6.697E+05	1.464E+08	-1.616E+10	1.008E+12	-3.601E+13	6.901E+14	-5.520E+15	0.000E+00	0.000E+00	0.961352
7	1.407E+00	9.104E+02	-6.605E+05	1.559E+08	-1.823E+10	1.181E+12	-4.295E+13	8.211E+14	-6.414E+15	0.000E+00	0.000E+00	0.944953
8	1.091E+00	1.732E+03	-1.445E+06	4.829E+08	-8.955E+10	1.027E+13	-7.580E+14	3.604E+16	-1.064E+18	1.773E+19	-1.270E+20	0.945378
9	1.875E+00	-3.521E+02	3.933E+04	-1.382E+06	1.409E+07	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.772297
10	1.249E+00	1.418E+03	-1.349E+06	5.421E+08	-1.219E+11	1.676E+13	-1.455E+15	7.985E+16	-2.681E+18	5.013E+19	-3.994E+20	0.972185
11	1.617E+00	-6.217E+01	-2.921E+03	-1.207E+06	3.109E+08	-1.587E+10	2.269E+11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.934947
12	1.653E+00	1.361E+02	-1.900E+05	5.557E+07	-7.440E+09	5.139E+11	-1.741E+13	2.274E+14	0.000E+00	0.000E+00	0.000E+00	0.963257
13	1.460E+00	3.958E+02	-3.073E+05	8.531E+07	-1.147E+10	8.045E+11	-2.781E+13	3.712E+14	0.000E+00	0.000E+00	0.000E+00	0.976407
14	1.954E+00	-8.287E+02	8.281E+05	-3.461E+08	7.306E+10	-8.658E+12	5.997E+14	-2.389E+16	5.023E+17	-4.272E+18	0.000E+00	0.971457
15	1.567E+00	5.273E+02	-5.481E+05	3.181E+08	-1.063E+11	2.067E+13	-2.401E+15	1.688E+17	-7.026E+18	1.589E+20	-1.503E+21	0.992145
16	1.934E+00	-9.573E+02	1.324E+06	-6.671E+08	1.639E+11	-2.232E+13	1.770E+15	-8.121E+16	1.992E+18	-2.020E+19	0.000E+00	0.981885
17	2.173E+00	-1.213E+03	1.533E+06	-7.708E+08	1.943E+11	-2.730E+13	2.235E+15	-1.056E+17	2.664E+18	-2.772E+19	0.000E+00	0.987992
18	1.984E+00	-3.992E+02	1.020E+06	-6.281E+08	1.756E+11	-2.626E+13	2.240E+15	-1.089E+17	2.802E+18	-2.958E+19	0.000E+00	0.987406
19	9.949E-01	2.845E+03	-2.151E+06	7.285E+08	-1.274E+11	1.231E+13	-6.582E+14	1.815E+16	-2.011E+17	0.000E+00	0.000E+00	0.976519
20	2.044E+00	-4.643E+02	9.463E+05	-5.023E+08	1.257E+11	-1.678E+13	1.228E+15	-4.619E+16	6.955E+17	0.000E+00	0.000E+00	0.994291
21	2.029E+00	1.390E+02	7.770E+05	-6.514E+08	2.176E+11	-3.729E+13	3.566E+15	-1.917E+17	5.404E+18	-6.210E+19	0.000E+00	0.986372
22	2.634E+00	-1.452E+03	2.554E+06	-1.515E+09	4.399E+11	-7.018E+13	6.458E+15	-3.405E+17	9.530E+18	-1.097E+20	0.000E+00	0.992264
23	2.735E+00	-1.578E+03	3.228E+06	-2.118E+09	6.760E+11	-1.200E+14	1.265E+16	-8.059E+17	3.039E+19	-6.226E+20	5.331E+21	0.987975
24	1.939E+00	2.620E+03	-2.725E+06	1.635E+09	-5.788E+11	1.263E+14	-1.717E+16	1.445E+18	-7.266E+19	1.991E+21	-2.281E+22	0.988789
25	3.171E+00	-2.137E+03	3.978E+06	-2.479E+09	7.524E+11	-1.252E+14	1.200E+16	-6.587E+17	1.917E+19	-2.292E+20	0.000E+00	0.986814
26	2.549E+00	5.177E+02	1.097E+06	-1.103E+09	4.116E+11	-7.741E+13	8.070E+15	-4.709E+17	1.436E+19	-1.781E+20	0.000E+00	0.983561

Table 76. LET Lookup tables for Primary Particles in TEP1 using equation y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9 (The lower case column headers are the equation coefficients)

Atomic No.	a	b	c	d	e	f	g	h	i	j	k	DoF adj. r2
1	2.631E-01	-6.925E+01	1.391E+05	-9.736E+07	4.009E+10	-9.568E+12	1.357E+15	-1.155E+17	5.773E+18	-1.557E+20	1.750E+21	0.990869
2	4.103E-01	1.507E+03	-1.703E+06	9.318E+08	-2.558E+11	3.907E+13	-3.456E+15	1.759E+17	-4.779E+18	5.369E+19	0.000E+00	0.986695
3	2.325E+00	-2.476E+03	2.628E+06	-1.006E+09	1.946E+11	-2.032E+13	1.163E+15	-3.442E+16	4.123E+17	0.000E+00	0.000E+00	0.989024
4	2.662E+00	1.385E+03	-1.955E+06	1.657E+09	-6.146E+11	1.174E+14	-1.191E+16	6.085E+17	-1.231E+19	0.000E+00	0.000E+00	0.992666
5	2.713E+00	5.901E+03	-4.383E+06	1.529E+09	-2.372E+11	1.838E+13	-7.223E+14	1.272E+16	-5.976E+16	0.000E+00	0.000E+00	0.968850
6	1.197E+01	-2.415E+04	3.623E+07	-2.378E+10	8.416E+12	-1.735E+15	2.183E+17	-1.705E+19	8.075E+20	-2.127E+22	2.391E+23	0.979917
7	6.536E+00	8.324E+03	-7.591E+06	3.268E+09	-4.572E+11	-9.545E+12	8.442E+15	-8.551E+17	3.639E+19	-5.821E+20	0.000E+00	0.980630
8	1.197E+01	-5.492E+03	1.529E+07	-1.426E+10	6.822E+12	-1.719E+15	2.412E+17	-1.905E+19	7.945E+20	-1.362E+22	0.000E+00	0.985641
9	2.068E+01	-1.925E+04	1.576E+07	-3.731E+09	4.108E+11	-2.358E+13	6.853E+14	-7.972E+15	0.000E+00	0.000E+00	0.000E+00	0.964766
10	9.609E+00	3.204E+04	-4.047E+07	2.463E+10	-7.344E+12	1.235E+15	-1.262E+17	8.036E+18	-3.118E+20	6.760E+21	-6.284E+22	0.988904
11	2.831E+01	-2.297E+04	2.059E+07	-5.235E+09	6.168E+11	-3.792E+13	1.182E+15	-1.479E+16	0.000E+00	0.000E+00	0.000E+00	0.978842
12	1.845E+01	2.755E+04	-3.709E+07	2.562E+10	-8.341E+12	1.501E+15	-1.626E+17	1.090E+19	-4.439E+20	1.007E+22	-9.763E+22	0.995974
13	3.089E+01	-6.386E+03	5.619E+06	1.927E+09	-1.161E+12	2.003E+14	-1.629E+16	6.469E+17	-1.011E+19	0.000E+00	0.000E+00	0.992421
14	4.019E+01	-2.375E+04	2.456E+07	-5.780E+09	3.894E+11	2.766E+13	-5.435E+15	2.848E+17	-5.132E+18	0.000E+00	0.000E+00	0.990789
15	4.757E+01	-3.488E+04	3.640E+07	-1.032E+10	1.266E+12	-6.777E+13	5.074E+14	8.724E+16	-2.413E+18	0.000E+00	0.000E+00	0.986864
16	1.013E+01	1.575E+05	-2.542E+08	1.935E+11	-7.512E+13	1.674E+16	-2.283E+18	1.940E+20	-1.002E+22	2.877E+23	-3.517E+24	0.959059
17	6.939E+01	-7.748E+04	7.992E+07	-2.635E+10	4.108E+12	-3.359E+14	1.395E+16	-2.324E+17	0.000E+00	0.000E+00	0.000E+00	0.949481
18	1.371E+01	1.891E+05	-3.089E+08	2.384E+11	-9.410E+13	2.141E+16	-2.995E+18	2.624E+20	-1.406E+22	4.221E+23	-5.439E+24	0.966536
19	2.507E+01	1.665E+05	-2.789E+08	2.239E+11	-9.119E+13	2.127E+16	-3.038E+18	2.710E+20	-1.476E+22	4.496E+23	-5.873E+24	0.982267
20	3.413E+01	1.530E+05	-2.643E+08	2.202E+11	-9.203E+13	2.188E+16	-3.173E+18	2.868E+20	-1.580E+22	4.863E+23	-6.411E+24	0.989548
21	3.449E+01	1.787E+05	-3.035E+08	2.487E+11	-1.029E+14	2.429E+16	-3.504E+18	3.154E+20	-1.732E+22	5.313E+23	-6.987E+24	0.988282
22	4.134E+01	1.772E+05	-3.072E+08	2.579E+11	-1.087E+14	2.613E+16	-3.837E+18	3.518E+20	-1.970E+22	6.172E+23	-8.299E+24	0.989738
23	9.725E+01	-5.065E+04	4.579E+07	1.853E+09	-6.433E+12	1.646E+15	-1.841E+17	9.840E+18	-2.055E+20	0.000E+00	0.000E+00	0.976862
24	6.007E+01	1.590E+05	-2.935E+08	2.628E+11	-1.154E+14	2.851E+16	-4.268E+18	3.966E+20	-2.241E+22	7.053E+23	-9.493E+24	0.996202
25	8.106E+01	8.904E+04	-1.759E+08	1.694E+11	-7.310E+13	1.674E+16	-2.202E+18	1.675E+20	-6.865E+21	1.174E+23	0.000E+00	0.994317
26	7.508E+01	1.666E+05	-3.332E+08	3.218E+11	-1.506E+14	3.943E+16	-6.248E+18	6.142E+20	-3.671E+22	1.223E+24	-1.743E+25	0.993547

Table 77. LET Lookup tables for Secondary Particles in TEP1 using equation y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9 (The lower case column headers are the equation coefficients)

Atomic No.	a	b	c	d	e	f	g	h	i	j	k	DoF adj. r2
1	2.833E-01	-2.684E+02	2.564E+05	-8.213E+07	1.279E+10	-1.013E+12	3.919E+13	-5.898E+14	0.000E+00	0.000E+00	0.000E+00	0.987467
2	9.107E-01	-7.908E+02	7.609E+05	-2.353E+08	3.529E+10	-2.682E+12	9.940E+13	-1.429E+15	0.000E+00	0.000E+00	0.000E+00	0.985990
3	2.325E+00	-2.476E+03	2.628E+06	-1.006E+09	1.946E+11	-2.032E+13	1.163E+15	-3.442E+16	4.123E+17	0.000E+00	0.000E+00	0.989024
4	2.662E+00	1.385E+03	-1.955E+06	1.657E+09	-6.146E+11	1.174E+14	-1.191E+16	6.085E+17	-1.231E+19	0.000E+00	0.000E+00	0.992666
5	2.713E+00	5.901E+03	-4.383E+06	1.529E+09	-2.372E+11	1.838E+13	-7.223E+14	1.272E+16	-5.976E+16	0.000E+00	0.000E+00	0.968850
6	1.197E+01	-2.415E+04	3.623E+07	-2.378E+10	8.416E+12	-1.735E+15	2.183E+17	-1.705E+19	8.075E+20	-2.127E+22	2.391E+23	0.979917
7	6.536E+00	8.324E+03	-7.591E+06	3.268E+09	-4.572E+11	-9.545E+12	8.442E+15	-8.551E+17	3.639E+19	-5.821E+20	0.000E+00	0.980630
8	1.197E+01	-5.492E+03	1.529E+07	-1.426E+10	6.822E+12	-1.719E+15	2.412E+17	-1.905E+19	7.945E+20	-1.362E+22	0.000E+00	0.985641
9	2.068E+01	-1.925E+04	1.576E+07	-3.731E+09	4.108E+11	-2.358E+13	6.853E+14	-7.972E+15	0.000E+00	0.000E+00	0.000E+00	0.964766
10	9.609E+00	3.204E+04	-4.047E+07	2.463E+10	-7.344E+12	1.235E+15	-1.262E+17	8.036E+18	-3.118E+20	6.760E+21	-6.284E+22	0.988904
11	2.831E+01	-2.297E+04	2.059E+07	-5.235E+09	6.168E+11	-3.792E+13	1.182E+15	-1.479E+16	0.000E+00	0.000E+00	0.000E+00	0.978842
12	1.845E+01	2.755E+04	-3.709E+07	2.562E+10	-8.341E+12	1.501E+15	-1.626E+17	1.090E+19	-4.439E+20	1.007E+22	-9.763E+22	0.995974
13	3.089E+01	-6.386E+03	5.619E+06	1.927E+09	-1.161E+12	2.003E+14	-1.629E+16	6.469E+17	-1.011E+19	0.000E+00	0.000E+00	0.992421
14	4.019E+01	-2.375E+04	2.456E+07	-5.780E+09	3.894E+11	2.766E+13	-5.435E+15	2.848E+17	-5.132E+18	0.000E+00	0.000E+00	0.990789
15	4.757E+01	-3.488E+04	3.640E+07	-1.032E+10	1.266E+12	-6.777E+13	5.074E+14	8.724E+16	-2.413E+18	0.000E+00	0.000E+00	0.986864
16	1.013E+01	1.575E+05	-2.542E+08	1.935E+11	-7.512E+13	1.674E+16	-2.283E+18	1.940E+20	-1.002E+22	2.877E+23	-3.517E+24	0.959059
17	6.939E+01	-7.748E+04	7.992E+07	-2.635E+10	4.108E+12	-3.359E+14	1.395E+16	-2.324E+17	0.000E+00	0.000E+00	0.000E+00	0.949481
18	1.371E+01	1.891E+05	-3.089E+08	2.384E+11	-9.410E+13	2.141E+16	-2.995E+18	2.624E+20	-1.406E+22	4.221E+23	-5.439E+24	0.966536
19	2.507E+01	1.665E+05	-2.789E+08	2.239E+11	-9.119E+13	2.127E+16	-3.038E+18	2.710E+20	-1.476E+22	4.496E+23	-5.873E+24	0.982267
20	3.413E+01	1.530E+05	-2.643E+08	2.202E+11	-9.203E+13	2.188E+16	-3.173E+18	2.868E+20	-1.580E+22	4.863E+23	-6.411E+24	0.989548
21	3.449E+01	1.787E+05	-3.035E+08	2.487E+11	-1.029E+14	2.429E+16	-3.504E+18	3.154E+20	-1.732E+22	5.313E+23	-6.987E+24	0.988282
22	4.134E+01	1.772E+05	-3.072E+08	2.579E+11	-1.087E+14	2.613E+16	-3.837E+18	3.518E+20	-1.970E+22	6.172E+23	-8.299E+24	0.989738
23	9.725E+01	-5.065E+04	4.579E+07	1.853E+09	-6.433E+12	1.646E+15	-1.841E+17	9.840E+18	-2.055E+20	0.000E+00	0.000E+00	0.976862
24	6.007E+01	1.590E+05	-2.935E+08	2.628E+11	-1.154E+14	2.851E+16	-4.268E+18	3.966E+20	-2.241E+22	7.053E+23	-9.493E+24	0.996202
25	8.106E+01	8.904E+04	-1.759E+08	1.694E+11	-7.310E+13	1.674E+16	-2.202E+18	1.675E+20	-6.865E+21	1.174E+23	0.000E+00	0.994317
26	7.508E+01	1.666E+05	-3.332E+08	3.218E+11	-1.506E+14	3.943E+16	-6.248E+18	6.142E+20	-3.671E+22	1.223E+24	-1.743E+25	0.993547

Table 78. LET Lookup tables for Primary Particles in Detector 3 using equation y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9 (The lower case column headers are the equation coefficients)

Atomic No.	a	b	c	d	e	f	g	h	i	j	k	DoF adj. r2
1	3.970E-01	-2.871E+02	5.172E+05	-4.189E+08	2.181E+11	-7.332E+13	1.596E+16	-2.224E+18	1.911E+20	-9.206E+21	1.902E+23	0.999996
2	1.311E+00	-9.319E+02	1.726E+06	-1.420E+09	7.474E+11	-2.514E+14	5.433E+16	-7.490E+18	6.358E+20	-3.026E+22	6.177E+23	0.999994
3	2.703E+00	-2.147E+03	3.500E+06	-2.366E+09	9.364E+11	-2.184E+14	2.947E+16	-2.121E+18	6.308E+19	0.000E+00	0.000E+00	0.999967
4	5.546E+00	-6.263E+03	1.089E+07	-8.625E+09	4.027E+12	-1.118E+15	1.806E+17	-1.561E+19	5.582E+20	0.000E+00	0.000E+00	0.999955
5	9.179E+00	-1.384E+04	2.775E+07	-2.665E+10	1.479E+13	-4.790E+15	8.894E+17	-8.747E+19	3.530E+21	0.000E+00	0.000E+00	0.999966
6	3.902E+01	-1.851E+05	4.334E+08	-5.015E+11	3.218E+14	-1.191E+17	2.518E+19	-2.820E+21	1.294E+23	0.000E+00	0.000E+00	0.997149
7	1.306E+01	4.010E+02	-8.578E+06	1.777E+10	-1.300E+13	4.688E+15	-8.266E+17	5.671E+19	0.000E+00	0.000E+00	0.000E+00	0.9999988
8	1.694E+01	-3.987E+03	4.037E+06	1.013E+09	-9.341E+11	1.582E+14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999993
9	2.413E+01	-2.805E+04	6.362E+07	-7.555E+10	5.560E+13	-2.364E+16	5.274E+18	-4.739E+20	0.000E+00	0.000E+00	0.000E+00	0.999927
10	2.643E+01	-1.253E+04	1.644E+07	-5.670E+09	8.252E+11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999881
11	3.183E+01	-1.569E+04	2.019E+07	-6.915E+09	1.018E+12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999974
12	3.760E+01	-1.979E+04	2.689E+07	-1.024E+10	1.677E+12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999957
13	4.249E+01	-2.036E+04	2.587E+07	-7.268E+09	2.088E+11	2.436E+14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999930
14	4.697E+01	-1.020E+04	4.101E+06	1.409E+10	-8.603E+12	1.593E+15	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999957
15	5.139E+01	-7.171E+03	-4.987E+06	2.549E+10	-1.410E+13	2.545E+15	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999972
16	6.525E+01	-4.944E+04	8.038E+07	-5.272E+10	2.088E+13	-4.178E+15	3.620E+17	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999908
17	3.963E+01	2.379E+05	-1.016E+09	2.196E+12	-2.703E+15	2.001E+18	-8.779E+20	2.096E+23	-2.092E+25	0.000E+00	0.000E+00	0.999888
18	6.186E+01	5.254E+04	-2.306E+08	4.301E+11	-3.973E+14	2.030E+17	-5.442E+19	5.986E+21	0.000E+00	0.000E+00	0.000E+00	0.999939
19	8.454E+01	-5.406E+04	7.824E+07	-3.519E+10	7.343E+12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999875
20	9.605E+01	-8.068E+04	1.191E+08	-5.982E+10	1.296E+13	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999855
21	9.191E+01	-2.401E+04	1.153E+07	3.282E+10	-2.315E+13	5.178E+15	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999641
22	1.108E+02	-9.313E+04	1.385E+08	-7.018E+10	1.524E+13	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999750
23	9.169E+01	6.772E+04	-2.354E+08	3.432E+11	-2.154E+14	6.253E+16	-6.441E+18	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999865
24	1.317E+02	-1.281E+05	2.031E+08	-1.163E+11	2.753E+13	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999171
25	1.137E+02	3.015E+04	-1.589E+08	2.502E+11	-1.378E+14	2.736E+16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999971
26	2.168E+02	-1.115E+06	5.623E+09	-1.573E+13	2.653E+16	-2.780E+19	1.822E+22	-7.233E+24	1.587E+27	-1.470E+29	0.000E+00	0.999965

Table 79. LET Lookup tables for Secondary Particles in Detector 3 using equation y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9 (The lower case column headers are the equation coefficients)

Atomic No.	a	b	c	d	e	f	g	h	i	j	k	DoF adj. r2
1	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	NA
2	1.555E+00	-1.299E+03	2.013E+06	-1.267E+09	4.517E+11	-9.321E+13	1.101E+16	-6.898E+17	1.777E+19	0.000E+00	0.000E+00	0.999934
3	2.881E+00	-8.456E+03	1.775E+07	-1.893E+10	1.162E+13	-4.349E+15	1.021E+18	-1.510E+20	1.365E+22	-6.886E+23	1.486E+25	0.993514
4	1.703E+00	-1.528E+03	2.269E+06	-1.536E+09	5.565E+11	-1.090E+14	1.078E+16	-4.177E+17	0.000E+00	0.000E+00	0.000E+00	0.965949
5	2.041E+00	-2.795E+03	6.877E+06	-7.816E+09	4.798E+12	-1.691E+15	3.490E+17	-4.147E+19	2.617E+21	-6.784E+22	0.000E+00	0.925790
6	2.712E+00	-3.098E+03	3.766E+06	-1.740E+09	3.394E+11	-2.291E+13	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.903014
7	9.604E+00	-4.667E+04	1.144E+08	-1.403E+11	9.705E+13	-3.996E+16	9.939E+18	-1.458E+21	1.159E+23	-3.837E+24	0.000E+00	0.897573
8	-1.360E+01	1.079E+05	-2.594E+08	3.121E+11	-2.110E+14	8.557E+16	-2.152E+19	3.377E+21	-3.215E+23	1.699E+25	-3.825E+26	0.867061
9	8.758E-01	1.395E+04	-1.474E+07	6.508E+09	-1.164E+12	7.100E+13	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.714114
10	2.498E+00	1.213E+04	-1.624E+07	1.028E+10	-3.109E+12	4.732E+14	-3.525E+16	1.025E+18	0.000E+00	0.000E+00	0.000E+00	0.969002
11	7.694E+00	-4.341E+03	8.689E+06	-5.230E+09	7.740E+11	3.900E+14	-1.400E+17	1.205E+19	0.000E+00	0.000E+00	0.000E+00	0.998319
12	3.390E+00	1.818E+04	-2.278E+07	1.242E+10	-2.715E+12	2.001E+14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.960887
13	1.609E+01	-4.563E+04	1.345E+08	-2.038E+11	1.831E+14	-1.004E+17	3.292E+19	-5.917E+21	4.468E+23	0.000E+00	0.000E+00	0.999000
14	6.397E+00	3.670E+04	-1.184E+08	2.014E+11	-1.901E+14	1.041E+17	-3.279E+19	5.498E+21	-3.787E+23	0.000E+00	0.000E+00	0.999197
15	2.578E+01	-8.382E+04	2.273E+08	-3.053E+11	2.277E+14	-9.447E+16	2.032E+19	-1.753E+21	0.000E+00	0.000E+00	0.000E+00	0.9997604
16	1.546E+01	-4.072E+03	1.326E+07	-1.282E+10	7.469E+12	-2.311E+15	3.073E+17	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999888
17	2.431E+01	-3.531E+04	8.019E+07	-7.941E+10	4.095E+13	-1.036E+16	1.031E+18	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999801
18	2.463E+01	-2.638E+03	1.210E+07	-1.010E+10	4.538E+12	-6.440E+14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.997927
19	1.596E+01	3.672E+04	-4.753E+07	2.708E+10	-4.702E+12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.977635
20	1.475E+01	5.392E+04	-7.082E+07	3.989E+10	-6.967E+12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.975770
21	1.463E+01	8.488E+04	-1.134E+08	6.322E+10	-1.102E+13	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.974283
22	4.358E+01	-2.216E+04	4.339E+07	-2.483E+10	5.778E+12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999696
23	5.004E+01	-2.609E+04	4.908E+07	-2.444E+10	3.416E+12	7.721E+14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999525
24	7.281E+01	-1.654E+05	4.159E+08	-4.902E+11	3.090E+14	-9.892E+16	1.282E+19	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999663
25	4.840E+01	3.741E+04	-7.927E+07	9.896E+10	-5.185E+13	1.033E+16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999898
26	9.242E+01	3.046E+05	-1.176E+09	2.203E+12	-2.217E+15	1.262E+18	-3.816E+20	4.775E+22	0.000E+00	0.000E+00	0.000E+00	0.999975

Table 80. LET Lookup tables for Primary Particles in Detector 4 using equation y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9 (The lower case column headers are the equation coefficients)

Atomic No.	a	b	c	d	e	f	g	h	i	j	k	DoF adj. r2
1	4.114E-01	-3.815E+02	7.076E+05	-6.140E+08	3.324E+11	-1.142E+14	2.517E+16	-3.534E+18	3.051E+20	-1.474E+22	3.048E+23	0.999992
2	1.339E+00	-1.186E+03	2.248E+06	-1.964E+09	1.068E+12	-3.661E+14	8.016E+16	-1.116E+19	9.542E+20	-4.568E+22	9.369E+23	0.9999945
3	2.788E+00	-2.665E+03	4.397E+06	-3.110E+09	1.265E+12	-2.999E+14	4.086E+16	-2.960E+18	8.828E+19	0.000E+00	0.000E+00	0.999953
4	3.951E+00	3.040E+03	-9.665E+06	1.388E+10	-9.773E+12	3.903E+15	-9.243E+17	1.285E+20	-9.678E+21	3.051E+23	0.000E+00	0.999987
5	6.636E+00	2.000E+03	-1.014E+07	1.886E+10	-1.609E+13	7.737E+15	-2.203E+18	3.673E+20	-3.306E+22	1.239E+24	0.000E+00	0.999979
6	-5.565E-01	6.525E+04	-1.585E+08	1.889E+11	-1.216E+14	4.459E+16	-9.289E+18	1.020E+21	-4.573E+22	0.000E+00	0.000E+00	0.995792
7	1.193E+01	9.101E+03	-3.699E+07	6.538E+10	-5.896E+13	3.160E+16	-1.050E+19	2.132E+21	-2.429E+23	1.189E+25	0.000E+00	0.999998
8	1.734E+01	-6.762E+03	9.065E+06	-2.887E+09	3.814E+11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999940
9	1.951E+01	-1.912E+03	3.478E+06	-2.026E+08	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999103
10	2.630E+01	-1.281E+04	1.680E+07	-5.872E+09	8.628E+11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999897
11	3.215E+01	-1.852E+04	2.571E+07	-1.137E+10	2.536E+12	-1.810E+14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999962
12	3.701E+01	-1.857E+04	2.670E+07	-1.274E+10	4.295E+12	-9.716E+14	1.231E+17	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999930
13	4.232E+01	-2.561E+04	5.342E+07	-5.951E+10	4.799E+13	-2.252E+16	5.417E+18	-5.060E+20	0.000E+00	0.000E+00	0.000E+00	0.999947
14	4.629E+01	-8.457E+03	3.898E+04	1.810E+10	-1.038E+13	1.884E+15	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999962
15	5.000E+01	-1.793E+03	-1.653E+07	3.636E+10	-1.871E+13	3.266E+15	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999967
16	6.437E+01	-4.731E+04	7.397E+07	-4.300E+10	1.348E+13	-1.502E+15	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999926
17	5.400E+01	8.734E+04	-4.030E+08	8.704E+11	-1.033E+15	7.394E+17	-3.161E+20	7.417E+22	-7.313E+24	0.000E+00	0.000E+00	0.999907
18	7.481E+01	-4.871E+04	6.741E+07	-2.835E+10	5.316E+12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999921
19	8.444E+01	-5.732E+04	8.311E+07	-3.823E+10	8.023E+12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999863
20	9.559E+01	-8.293E+04	1.237E+08	-6.352E+10	1.394E+13	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999811
21	-1.521E+08	2.000E+07	1.711E+08	-4.551E+04	2.916E+09	-2.116E+05	-1.431E+10	1.867E+04	2.079E+10	-5.252E+02	0.000E+00	0.999669
22	1.109E+02	-9.836E+04	1.470E+08	-7.571E+10	1.653E+13	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999701
23	1.213E+02	-1.202E+05	1.841E+08	-9.955E+10	2.206E+13	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999629
24	1.135E+02	-2.836E+04	-3.086E+06	7.480E+10	-5.343E+13	1.278E+16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999199
25	1.071E+02	6.351E+04	-2.331E+08	3.258E+11	-1.738E+14	3.384E+16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999953
26	2.517E+02	-1.489E+06	7.226E+09	-1.947E+13	3.176E+16	-3.239E+19	2.074E+22	-8.073E+24	1.739E+27	-1.585E+29	0.000E+00	0.999982

Table 81. LET Lookup tables for Secondary Particles in Detector 4 using equation y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9 (The lower case column headers are the equation coefficients)

Atomic No.	a	b	c	d	e	f	g	h	i	j	k	DoF adj. r2
1	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	NA
2	1.213E+00	4.619E+02	-1.064E+06	1.302E+09	-7.203E+11	2.198E+14	-3.918E+16	4.061E+18	-2.268E+20	5.278E+21	0.000E+00	0.999974
3	3.514E+00	-6.775E+03	1.857E+07	-2.340E+10	1.577E+13	-6.185E+15	1.481E+18	-2.199E+20	1.976E+22	-9.853E+23	2.094E+25	0.975795
4	1.974E+00	4.637E+03	-8.131E+06	6.618E+09	-2.802E+12	6.618E+14	-8.875E+16	6.359E+18	-1.896E+20	0.000E+00	0.000E+00	0.905801
5	2.483E+00	5.327E+03	-1.014E+07	9.291E+09	-4.601E+12	1.314E+15	-2.176E+17	1.945E+19	-7.231E+20	0.000E+00	0.000E+00	0.900206
6	-6.692E-01	1.346E+04	-2.391E+07	1.951E+10	-8.040E+12	1.727E+15	-1.839E+17	7.650E+18	0.000E+00	0.000E+00	0.000E+00	0.927301
7	5.367E+00	-2.477E+03	4.431E+06	-2.966E+09	8.713E+11	-1.033E+14	3.572E+15	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.768293
8	-1.113E+01	1.091E+05	-2.650E+08	3.230E+11	-2.210E+14	9.047E+16	-2.293E+19	3.625E+21	-3.476E+23	1.850E+25	-4.197E+26	0.914532
9	4.367E+00	1.107E+04	-1.108E+07	4.401E+09	-7.053E+11	3.766E+13	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.634515
10	9.534E+00	-1.190E+04	2.937E+07	-2.807E+10	1.284E+13	-2.980E+15	3.378E+17	-1.487E+19	0.000E+00	0.000E+00	0.000E+00	0.973518
11	1.176E+01	-1.298E+04	2.535E+07	-1.955E+10	6.483E+12	-7.547E+14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.951909
12	1.144E+01	-7.198E+03	1.636E+07	-1.019E+10	-1.515E+12	3.769E+15	-1.404E+18	2.110E+20	-1.146E+22	0.000E+00	0.000E+00	0.990391
13	1.164E+01	2.316E+03	7.415E+05	-2.227E+09	1.177E+12	-1.532E+14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.986262
14	3.253E+01	-1.298E+05	3.383E+08	-4.347E+11	3.063E+14	-1.201E+17	2.455E+19	-2.032E+21	0.000E+00	0.000E+00	0.000E+00	0.995859
15	1.656E+01	-1.238E+03	7.618E+06	-1.011E+10	7.304E+12	-2.497E+15	3.343E+17	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.9990236
16	2.588E+01	-6.075E+04	1.749E+08	-2.450E+11	1.881E+14	-7.970E+16	1.743E+19	-1.524E+21	0.000E+00	0.000E+00	0.000E+00	0.999477
17	2.844E+01	-5.133E+04	1.469E+08	-2.035E+11	1.562E+14	-6.649E+16	1.469E+19	-1.306E+21	0.000E+00	0.000E+00	0.000E+00	0.999299
18	3.057E+01	-1.081E+04	1.182E+07	-1.812E+09	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.981875
19	3.226E+01	-3.344E+04	7.992E+07	-8.124E+10	4.338E+13	-1.155E+16	1.259E+18	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.997961
20	2.037E+01	8.966E+04	-3.199E+08	5.822E+11	-5.711E+14	3.095E+17	-8.688E+19	9.846E+21	0.000E+00	0.000E+00	0.000E+00	0.998717
21	5.401E+01	-9.825E+04	1.980E+08	-1.667E+11	6.415E+13	-8.882E+15	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.998062
22	4.762E+01	-2.902E+04	5.592E+07	-3.372E+10	7.992E+12	-1.015E+14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999209
23	3.103E+01	1.783E+05	-6.846E+08	1.302E+12	-1.312E+15	7.237E+17	-2.057E+20	2.358E+22	0.000E+00	0.000E+00	0.000E+00	0.999769
24	5.433E+01	1.916E+04	-2.068E+08	5.881E+11	-7.320E+14	4.647E+17	-1.465E+20	1.826E+22	0.000E+00	0.000E+00	0.000E+00	0.999710
25	5.425E+01	2.304E+04	-5.338E+07	8.087E+10	-4.791E+13	1.042E+16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999891
26	5.261E+01	2.419E+05	-1.603E+09	4.870E+12	-8.131E+15	8.162E+18	-5.058E+21	1.897E+24	-3.956E+26	3.525E+28	0.000E+00	0.999839

Table 82. LET Lookup tables for Primary Particles in TEP2 using equation y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9 (The lower case column headers are the equation coefficients)

Atomic No.	a	b	c	d	e	f	g	h	i	j	k	DoF adj. r2
1	-2.279E-02	1.033E+03	-1.943E+06	1.769E+09	-8.616E+11	2.425E+14	-4.056E+16	3.972E+18	-2.098E+20	4.607E+21	0.000E+00	0.997508
2	9.170E-01	-1.782E+03	2.451E+06	-1.410E+09	4.173E+11	-6.539E+13	5.152E+15	-1.601E+17	0.000E+00	0.000E+00	0.000E+00	0.995224
3	-4.178E-01	7.988E+03	-1.495E+07	1.339E+10	-6.327E+12	1.674E+15	-2.490E+17	1.942E+19	-6.169E+20	0.000E+00	0.000E+00	0.994126
4	1.124E+00	-7.332E+02	1.277E+06	-1.021E+09	4.796E+11	-1.492E+14	2.991E+16	-3.560E+18	2.247E+20	-5.747E+21	0.000E+00	0.976833
5	4.447E+00	-4.890E+03	4.196E+06	6.277E+09	-1.258E+13	8.819E+15	-3.146E+18	6.052E+20	-5.957E+22	2.349E+24	0.000E+00	0.975925
6	4.717E+00	1.034E+03	-5.297E+06	7.759E+09	-1.854E+12	-3.713E+15	3.675E+18	-1.529E+21	3.351E+23	-3.770E+25	1.714E+27	0.999993
7	1.193E+01	9.101E+03	-3.699E+07	6.538E+10	-5.896E+13	3.160E+16	-1.050E+19	2.132E+21	-2.429E+23	1.189E+25	0.000E+00	0.999998
8	8.501E+00	-3.663E+03	5.124E+06	-1.742E+09	2.577E+11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999960
9	1.119E+01	-1.023E+04	2.071E+07	-2.098E+10	1.400E+13	-5.534E+15	1.163E+18	-9.831E+19	0.000E+00	0.000E+00	0.000E+00	0.999955
10	1.339E+01	-9.479E+03	1.324E+07	-5.649E+09	9.743E+11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999945
11	1.419E+01	5.674E+01	-1.103E+07	2.560E+10	-2.136E+13	9.308E+15	-2.124E+18	2.057E+20	0.000E+00	0.000E+00	0.000E+00	0.999978
12	1.777E+01	-8.254E+03	1.153E+07	-4.133E+09	7.532E+11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999946
13	1.780E+01	6.141E+03	-2.548E+07	4.071E+10	-2.612E+13	7.808E+15	-8.690E+17	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999931
14	1.579E+01	2.381E+04	-3.441E+07	2.178E+10	-3.862E+12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.990973
15	1.381E+01	4.165E+04	-5.910E+07	3.513E+10	-6.165E+12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.980045
16	2.849E+01	-8.131E+03	1.609E+06	1.591E+10	-1.121E+13	2.535E+15	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999966
17	2.667E+01	3.041E+04	-1.407E+08	2.842E+11	-2.948E+14	1.760E+17	-5.935E+19	1.008E+22	-5.901E+23	0.000E+00	0.000E+00	0.9999693
18	3.286E+01	-8.478E+03	2.717E+05	1.722E+10	-8.578E+12	2.110E+13	5.840E+17	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999917
19	4.181E+01	-3.762E+04	5.798E+07	-3.070E+10	7.220E+12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999888
20	2.665E+01	8.866E+04	-2.828E+08	4.216E+11	-3.075E+14	1.103E+17	-1.528E+19	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999836
21	4.043E+01	6.263E+03	-5.474E+07	1.200E+11	-1.020E+14	4.097E+16	-6.108E+18	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999639
22	6.091E+01	-1.082E+05	2.204E+08	-1.998E+11	8.911E+13	-1.449E+16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999038
23	3.215E+01	6.575E+04	-1.133E+08	8.233E+10	-1.703E+13	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.993631
24	-4.793E+00	4.468E+05	-1.415E+09	2.173E+12	-1.707E+15	6.637E+17	-1.002E+20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.998597
25	1.052E+02	-4.564E+05	1.584E+09	-2.909E+12	3.049E+15	-1.802E+18	5.579E+20	-6.983E+22	0.000E+00	0.000E+00	0.000E+00	0.999913
26	7.553E+01	-1.548E+05	4.838E+08	-7.922E+11	7.249E+14	-3.351E+17	6.163E+19	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999868

Table 83. LET Lookup tables for Secondary Particles in TEP2 using equation y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9 (The lower case column headers are the equation coefficients)

Atomic No.	a	b	c	d	e	f	g	h	i	j	k	DoF adj. r2
1	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	NA
2	1.590E-01	4.161E+02	-5.985E+05	4.705E+08	-2.103E+11	5.498E+13	-8.581E+15	7.874E+17	-3.916E+19	8.133E+20	0.000E+00	0.979444
3	7.558E-01	1.314E+03	-2.404E+06	2.183E+09	-1.108E+12	3.371E+14	-6.314E+16	7.114E+18	-4.400E+20	1.142E+22	0.000E+00	0.967406
4	9.685E-01	9.843E+01	-3.078E+05	4.367E+08	-2.575E+11	6.963E+13	-9.198E+15	5.737E+17	-1.331E+19	0.000E+00	0.000E+00	0.977803
5	1.258E+00	-1.105E+03	2.736E+06	-2.968E+09	1.655E+12	-4.850E+14	6.572E+16	-9.890E+17	-6.300E+20	4.424E+22	0.000E+00	0.998639
6	2.304E+00	-7.133E+03	1.910E+07	-2.564E+10	1.979E+13	-9.308E+15	2.727E+18	-4.951E+20	5.364E+22	-3.148E+24	7.605E+25	0.999543
7	2.125E+00	-2.852E+03	6.210E+06	-5.577E+09	2.038E+12	9.493E+13	-3.150E+17	1.011E+20	-1.368E+22	6.940E+23	0.000E+00	0.999558
8	1.891E+00	1.177E+03	-1.074E+06	4.565E+08	-5.516E+10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.989747
9	3.047E+00	1.977E+02	2.091E+05	-7.381E+07	2.720E+10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.997808
10	6.701E+00	-2.250E+04	6.114E+07	-8.087E+10	5.816E+13	-2.299E+16	4.686E+18	-3.838E+20	0.000E+00	0.000E+00	0.000E+00	0.999116
11	5.176E+00	-3.849E+03	1.037E+07	-1.224E+10	7.612E+12	-2.275E+15	2.600E+17	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999648
12	4.260E+00	4.617E+03	-8.196E+06	7.181E+09	-2.597E+12	3.464E+14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999392
13	5.330E+00	7.860E+03	-1.748E+07	1.961E+10	-1.039E+13	2.648E+15	-2.548E+17	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999321
14	6.458E+00	2.945E+03	-3.217E+06	2.243E+09	-3.690E+11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.997236
15	1.100E+01	-7.005E+03	7.347E+06	-1.365E+09	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.973655
16	4.542E+00	2.329E+04	-3.123E+07	1.749E+10	-3.022E+12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.962741
17	1.254E+01	-1.072E+03	-3.404E+06	1.457E+10	-1.233E+13	4.133E+15	-4.373E+17	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999791
18	1.863E+01	-1.515E+04	2.786E+07	-1.707E+10	4.033E+12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.997515
19	1.803E-01	1.336E+05	-4.465E+08	7.542E+11	-6.940E+14	3.558E+17	-9.540E+19	1.044E+22	0.000E+00	0.000E+00	0.000E+00	0.999660
20	7.292E+00	8.187E+04	-2.549E+08	3.976E+11	-3.292E+14	1.491E+17	-3.471E+19	3.259E+21	0.000E+00	0.000E+00	0.000E+00	0.999270
21	3.081E+01	-5.544E+04	1.188E+08	-1.098E+11	5.181E+13	-1.151E+16	9.948E+17	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999424
22	1.504E+01	9.822E+04	-3.608E+08	6.550E+11	-6.240E+14	3.224E+17	-8.486E+19	8.910E+21	0.000E+00	0.000E+00	0.000E+00	0.999740
23	2.193E+01	3.222E+04	-4.814E+07	3.435E+10	-6.901E+12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.992397
24	2.185E+01	9.045E+04	-3.396E+08	5.993E+11	-5.124E+14	2.097E+17	-3.256E+19	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999564
25	4.428E+01	-5.634E+04	1.111E+08	-7.800E+10	2.069E+13	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999710
26	6.294E+01	-1.902E+05	5.280E+08	-7.231E+11	5.468E+14	-2.156E+17	3.499E+19	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999785

Table 84. LET Lookup tables for Primary Particles in Detector 5 using equation y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9 (The lower case column headers are the equation coefficients)

Atomic No.	a	b	c	d	e	f	g	h	i	j	k	DoF adj. r2
1	1.980E-01	-1.778E+02	3.045E+05	-2.230E+08	9.645E+10	-2.468E+13	3.659E+15	-2.897E+17	9.485E+18	0.000E+00	0.000E+00	0.999972
2	5.495E-01	-5.087E+02	1.032E+06	-9.907E+08	6.123E+11	-2.441E+14	6.341E+16	-1.066E+19	1.118E+21	-6.637E+22	1.704E+24	0.999990
3	1.875E+00	-1.287E+03	2.181E+06	-1.636E+09	8.088E+11	-2.489E+14	4.500E+16	-4.332E+18	1.711E+20	0.000E+00	0.000E+00	0.999986
4	6.186E+00	-2.176E+04	6.355E+07	-9.894E+10	9.219E+13	-5.362E+16	1.988E+19	-4.688E+21	6.787E+23	-5.493E+25	1.900E+27	0.999945
5	5.745E+00	-3.573E+03	5.809E+06	-4.380E+09	2.585E+12	-1.073E+15	2.826E+17	-4.142E+19	2.551E+21	0.000E+00	0.000E+00	0.999974
6	7.457E+00	-5.499E+02	-3.320E+06	7.922E+09	-5.292E+12	1.530E+15	-1.616E+17	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999777
7	9.841E+00	9.918E+02	-1.453E+07	3.070E+10	-2.569E+13	1.052E+16	-1.870E+18	2.558E+19	2.145E+22	0.000E+00	0.000E+00	0.999724
8	1.112E+01	6.636E+03	-2.808E+07	4.828E+10	-3.884E+13	1.673E+16	-3.697E+18	3.295E+20	0.000E+00	0.000E+00	0.000E+00	0.999786
9	1.609E+01	-1.030E+04	1.366E+07	-5.408E+09	9.080E+11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999904
10	1.736E+01	2.244E+02	-1.041E+07	1.859E+10	-9.320E+12	1.589E+15	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999968
11	-4.031E-01	1.793E+05	-6.174E+08	1.087E+12	-1.078E+15	6.272E+17	-2.094E+20	3.654E+22	-2.511E+24	0.000E+00	0.000E+00	0.999997
12	2.531E+01	-6.083E+03	8.638E+05	1.128E+10	-7.011E+12	1.405E+15	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999864
13	3.510E+01	-4.817E+04	1.005E+08	-1.061E+11	6.642E+13	-2.160E+16	2.849E+18	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999574
14	3.672E+01	-3.312E+04	6.845E+07	-7.503E+10	5.390E+13	-2.019E+16	3.055E+18	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999886
15	3.255E+01	1.620E+04	-6.536E+07	9.866E+10	-5.995E+13	1.605E+16	-1.336E+18	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999915
16	2.988E+01	6.304E+04	-1.777E+08	2.161E+11	-1.106E+14	2.095E+16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999916
17	6.612E+01	-1.803E+05	5.033E+08	-7.232E+11	5.698E+14	-2.263E+17	3.553E+19	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999973
18	3.153E+01	1.220E+05	-4.652E+08	8.486E+11	-8.321E+14	4.652E+17	-1.396E+20	1.752E+22	0.000E+00	0.000E+00	0.000E+00	0.999947
19	4.750E+01	2.333E+04	-9.540E+07	1.392E+11	-7.593E+13	1.560E+16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999858
20	4.413E+01	7.143E+04	-2.211E+08	2.902E+11	-1.590E+14	3.296E+16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999793
21	-4.140E+01	9.364E+05	-3.585E+09	7.056E+12	-7.768E+15	4.842E+18	-1.591E+21	2.139E+23	0.000E+00	0.000E+00	0.000E+00	0.999697
22	7.487E+01	-1.106E+05	3.203E+08	-5.107E+11	4.667E+14	-2.120E+17	3.785E+19	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999675
23	4.695E+01	1.232E+05	-3.497E+08	4.407E+11	-2.400E+14	4.982E+16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999850
24	7.394E+01	5.950E+03	-1.394E+08	2.986E+11	-2.175E+14	5.635E+16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999229
25	1.210E+02	-3.849E+05	1.205E+09	-1.961E+12	1.746E+15	-7.865E+17	1.411E+20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999959
26	9.656E+01	-1.031E+05	1.763E+08	-1.182E+11	3.733E+13	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999548

Table 85. LET Lookup tables for Secondary Particles in Detector 5 using equation y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9 (The lower case column headers are the equation coefficients)

Atomic No.	a	b	c	d	e	f	g	h	i	j	k	DoF adj. r2
1	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	NA
2	5.519E-01	-1.180E+02	-9.012E+04	6.250E+08	-6.332E+11	2.913E+14	-7.416E+16	1.112E+19	-9.787E+20	4.671E+22	-9.333E+23	0.776705
3	6.772E-01	6.547E+03	-1.297E+07	1.261E+10	-6.848E+12	2.215E+15	-4.369E+17	5.142E+19	-3.312E+21	8.958E+22	0.000E+00	0.926157
4	1.818E+00	3.737E+03	-7.150E+06	4.544E+09	-2.647E+11	-9.046E+14	4.348E+17	-9.013E+19	9.045E+21	-3.585E+23	0.000E+00	0.870320
5	3.663E+00	-2.480E+03	2.828E+06	-1.660E+09	5.177E+11	-7.542E+13	4.006E+15	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.855060
6	8.473E+00	-3.383E+04	8.493E+07	-1.012E+11	6.273E+13	-1.974E+16	2.108E+18	4.874E+20	-1.813E+23	2.148E+25	-9.189E+26	0.582882
7	4.809E+00	-2.116E+02	3.368E+05	-2.296E+08	6.973E+10	-7.567E+12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.457864
8	5.536E+00	3.638E+03	-7.273E+06	5.438E+09	-1.683E+12	1.537E+14	1.088E+16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.831873
9	9.725E+00	-1.206E+04	2.163E+07	-1.545E+10	4.770E+12	-5.160E+14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.882219
10	3.907E+00	2.900E+04	-6.989E+07	8.065E+10	-4.637E+13	1.274E+16	-1.317E+18	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.979204
11	1.231E+01	-8.512E+03	1.876E+07	-2.063E+10	1.218E+13	-3.569E+15	4.180E+17	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.986885
12	1.272E+01	-5.428E+03	5.132E+06	-9.223E+08	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.884197
13	1.030E+01	1.724E+04	-2.430E+07	1.390E+10	-2.417E+12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.933045
14	1.888E+01	-1.520E+04	1.352E+07	1.664E+10	-2.966E+13	1.578E+16	-3.323E+18	2.193E+20	0.000E+00	0.000E+00	0.000E+00	0.954411
15	7.227E+00	5.177E+04	-7.207E+07	3.954E+10	-6.760E+12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.964609
16	3.537E+01	-1.166E+05	3.747E+08	-6.235E+11	5.778E+14	-2.960E+17	7.803E+19	-8.193E+21	0.000E+00	0.000E+00	0.000E+00	0.988908
17	1.325E+01	7.190E+04	-1.708E+08	1.917E+11	-1.017E+14	2.359E+16	-1.491E+18	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.998439
18	5.371E+01	-1.432E+05	3.502E+08	-4.274E+11	2.848E+14	-9.776E+16	1.370E+19	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.997724
19	2.494E+01	3.145E+04	-5.328E+07	3.866E+10	-8.135E+12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.987248
20	2.129E+01	6.789E+04	-1.194E+08	8.594E+10	-1.904E+13	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.937806
21	8.341E+01	-2.610E+05	5.836E+08	-5.799E+11	2.671E+14	-4.522E+16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.991926
22	-4.291E+01	8.109E+05	-2.889E+09	5.318E+12	-5.473E+15	3.190E+18	-9.837E+20	1.249E+23	0.000E+00	0.000E+00	0.000E+00	0.997700
23	1.511E+02	-5.974E+05	1.318E+09	-1.302E+12	5.945E+14	-9.987E+16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.986990
24	8.363E+01	-2.329E+05	8.878E+08	-1.879E+12	2.349E+15	-1.656E+18	6.008E+20	-8.618E+22	0.000E+00	0.000E+00	0.000E+00	0.998960
25	1.761E+02	-8.824E+05	2.772E+09	-4.514E+12	4.231E+15	-2.339E+18	7.614E+20	-1.436E+23	1.417E+25	0.000E+00	0.000E+00	0.999301
26	-1.188E+02	2.086E+06	-9.278E+09	2.166E+13	-2.929E+16	2.379E+19	-1.143E+22	2.987E+24	-3.260E+26	0.000E+00	0.000E+00	0.999834

Table 86. LET Lookup tables for Primary Particles in Detector 6 using equation y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9 (The lower case column headers are the equation coefficients)

Atomic No.	a	b	c	d	e	f	g	h	i	j	k	DoF adj. r2
1	1.802E-01	-1.078E+02	2.028E+05	-1.799E+08	1.160E+11	-5.077E+13	1.455E+16	-2.666E+18	3.000E+20	-1.887E+22	5.073E+23	0.9999976
2	5.462E-01	-5.950E+02	1.269E+06	-1.314E+09	8.541E+11	-3.516E+14	9.291E+16	-1.571E+19	1.641E+21	-9.653E+22	2.444E+24	0.999990
3	1.879E+00	-1.460E+03	2.507E+06	-1.955E+09	9.833E+11	-3.039E+14	5.485E+16	-5.262E+18	2.071E+20	0.000E+00	0.000E+00	0.999989
4	9.909E+00	-5.068E+04	1.509E+08	-2.369E+11	2.198E+14	-1.269E+17	4.665E+19	-1.090E+22	1.564E+24	-1.255E+26	4.306E+27	0.999823
5	5.336E+00	-1.244E+03	-2.730E+05	3.467E+09	-2.933E+12	1.116E+15	-2.027E+17	1.424E+19	0.000E+00	0.000E+00	0.000E+00	0.999986
6	7.761E+00	-3.562E+03	4.523E+06	-1.438E+09	1.926E+11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999742
7	1.043E+01	-5.865E+03	7.615E+06	-2.731E+09	4.047E+11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999916
8	1.310E+01	-8.031E+03	1.060E+07	-4.039E+09	6.474E+11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999917
9	1.629E+01	-1.317E+04	2.104E+07	-1.428E+10	6.219E+12	-1.525E+15	1.662E+17	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999988
10	1.821E+01	-7.832E+03	1.095E+07	-7.310E+09	6.256E+12	-2.943E+15	5.093E+17	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999981
11	1.364E+01	2.808E+04	-4.240E+07	2.674E+10	-5.001E+12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.981872
12	2.767E+01	-2.162E+04	3.362E+07	-2.129E+10	8.699E+12	-1.539E+15	-1.804E+17	9.558E+19	0.000E+00	0.000E+00	0.000E+00	0.999836
13	3.406E+01	-5.377E+04	1.482E+08	-2.230E+11	2.013E+14	-1.025E+17	2.711E+19	-2.874E+21	0.000E+00	0.000E+00	0.000E+00	0.999754
14	3.738E+01	-4.063E+04	8.736E+07	-9.834E+10	6.892E+13	-2.508E+16	3.691E+18	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999868
15	3.101E+01	2.285E+04	-8.088E+07	1.157E+11	-6.947E+13	1.856E+16	-1.571E+18	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999915
16	4.964E+01	-8.110E+04	2.084E+08	-2.867E+11	2.293E+14	-9.345E+16	1.514E+19	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999982
17	5.278E+00	3.383E+05	-1.271E+09	2.415E+12	-2.550E+15	1.530E+18	-4.865E+20	6.363E+22	0.000E+00	0.000E+00	0.000E+00	0.999996
18	6.132E+01	-1.288E+05	3.479E+08	-4.967E+11	4.000E+14	-1.629E+17	2.619E+19	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999954
19	5.969E+01	-5.821E+04	8.956E+07	-5.060E+10	1.337E+13	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999507
20	4.661E+01	4.541E+04	-1.414E+08	1.698E+11	-6.387E+13	-4.864E+15	5.983E+18	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999765
21	-4.046E+01	9.170E+05	-3.499E+09	6.863E+12	-7.529E+15	4.678E+18	-1.533E+21	2.057E+23	0.000E+00	0.000E+00	0.000E+00	0.999744
22	7.876E+01	-1.468E+05	4.281E+08	-6.717E+11	5.946E+14	-2.636E+17	4.616E+19	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999630
23	4.387E+01	1.384E+05	-3.882E+08	4.856E+11	-2.645E+14	5.490E+16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999812
24	6.622E+01	5.324E+04	-2.606E+08	4.422E+11	-2.972E+14	7.308E+16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999359
25	1.253E+02	-4.365E+05	1.396E+09	-2.310E+12	2.080E+15	-9.453E+17	1.709E+20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999963
26	9.546E+01	-1.040E+05	1.807E+08	-1.241E+11	3.961E+13	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999515

Table 87. LET Lookup tables for Secondary Particles in Detector 6 using equation y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9 (The lower case column headers are the equation coefficients)

Atomic No.	a	b	c	d	e	f	g	h	i	j	k	DoF adj. r2
1	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	NA
2	1.395E-01	2.147E+03	-2.545E+06	1.519E+09	-5.335E+11	1.130E+14	-1.410E+16	9.494E+17	-2.657E+19	0.000E+00	0.000E+00	0.887323
3	1.954E+00	1.147E+03	-2.016E+06	1.600E+09	-6.963E+11	1.828E+14	-2.939E+16	2.650E+18	-1.008E+20	0.000E+00	0.000E+00	0.904829
4	3.817E+00	-8.292E+03	1.929E+07	-2.268E+10	1.516E+13	-6.094E+15	1.499E+18	-2.207E+20	1.785E+22	-6.091E+23	0.000E+00	0.955843
5	3.764E+00	-2.448E+03	3.706E+06	-2.536E+09	8.113E+11	-1.167E+14	6.098E+15	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.889207
6	6.130E+00	-1.611E+04	4.245E+07	-5.582E+10	4.122E+13	-1.808E+16	4.781E+18	-7.462E+20	6.312E+22	-2.228E+24	0.000E+00	0.963708
7	3.906E+00	3.637E+03	-4.069E+06	1.789E+09	-3.268E+11	2.034E+13	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.842447
8	5.386E+00	4.359E+03	-9.643E+06	8.971E+09	-3.474E+12	4.676E+14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.913725
9	8.430E+00	-2.424E+03	1.289E+06	4.774E+09	-5.630E+12	2.129E+15	-2.612E+17	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.994927
10	9.435E+00	-4.309E+03	9.528E+06	-7.482E+09	2.325E+12	-2.142E+14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.994884
11	1.104E+01	-2.539E+03	6.207E+06	-5.023E+09	1.624E+12	-1.320E+14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.995080
12	1.389E+01	-7.099E+03	6.313E+06	-1.180E+09	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.900537
13	9.484E+00	2.132E+04	-2.905E+07	1.608E+10	-2.754E+12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.974211
14	1.605E+01	2.082E+03	-1.667E+07	3.507E+10	-2.894E+13	1.068E+16	-1.422E+18	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.994425
15	2.050E+01	-7.881E+03	1.448E+07	-8.769E+09	2.254E+12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.996896
16	1.468E+01	3.755E+04	-8.071E+07	7.805E+10	-3.137E+13	3.285E+15	5.816E+17	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.998309
17	-1.447E+02	1.877E+06	-8.635E+09	2.175E+13	-3.327E+16	3.221E+19	-1.982E+22	7.504E+24	-1.590E+27	1.439E+29	0.000E+00	0.999690
18	3.209E+01	6.862E+03	-4.349E+07	7.806E+10	-4.953E+13	1.095E+16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.998675
19	2.414E+01	3.735E+04	-6.298E+07	4.510E+10	-9.602E+12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.980674
20	6.750E+01	-1.968E+05	4.183E+08	-3.997E+11	1.793E+14	-2.977E+16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.986708
21	8.960E+01	-2.958E+05	6.573E+08	-6.490E+11	2.966E+14	-4.988E+16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.992879
22	5.888E+01	-5.112E+04	7.353E+07	-1.679E+10	-1.652E+13	7.968E+15	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.998802
23	1.594E+02	-6.484E+05	1.435E+09	-1.420E+12	6.474E+14	-1.084E+17	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.988350
24	5.633E+01	5.332E+04	-2.736E+08	5.411E+11	-4.588E+14	1.716E+17	-2.155E+19	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.999583
25	1.406E+01	5.928E+05	-2.557E+09	5.483E+12	-6.420E+15	4.210E+18	-1.454E+21	2.065E+23	0.000E+00	0.000E+00	0.000E+00	0.999898
26	-2.186E+01	1.157E+06	-5.656E+09	1.422E+13	-2.045E+16	1.758E+19	-8.925E+21	2.466E+24	-2.850E+26	0.000E+00	0.000E+00	0.999752

Table 88. LET Lookup tables for Primary Particles in Detector 1 with Delta Ray Correction for Protons and Alphas using equation y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9 (The lower case column headers are the equation coefficients)

Atomic No.	a	b	c	d	e	f	g	h	i	j	k	DoF adj. r2
1	0.305651	68.962224	17175.457	-2819106	229155252	-1.03E+10	2.622E+11	-3.49E+12	1.891E+13	0.000E+00	0.000E+00	0.999987
2	1.221173	278.84132	64953.854	-10655553	864473199	-3.89E+10	9.819E+11	-1.3E+13	6.991E+13	0.000E+00	0.000E+00	0.999986
3	3.324E+00	3.967E+02	1.799E+05	-2.622E+07	2.012E+09	-8.764E+10	2.170E+12	-2.834E+13	1.511E+14	0.000E+00	0.000E+00	0.999980
4	6.176E+00	2.492E+01	7.848E+05	-1.792E+08	2.336E+10	-1.874E+12	9.528E+13	-3.067E+15	6.036E+16	-6.607E+17	3.073E+18	0.999995
5	9.765E+00	-3.391E+02	1.593E+06	-4.193E+08	6.344E+10	-5.910E+12	3.492E+14	-1.308E+16	3.002E+17	-3.844E+18	2.100E+19	0.999995
6	1.374E+01	4.779E+02	1.430E+06	-2.900E+08	3.306E+10	-2.264E+12	9.504E+13	-2.387E+15	3.285E+16	-1.898E+17	0.000E+00	0.999993
7	1.854E+01	1.036E+03	1.669E+06	-3.083E+08	3.101E+10	-1.776E+12	5.717E+13	-9.126E+14	3.929E+15	3.779E+16	0.000E+00	0.999997
8	1.907E+01	1.103E+04	-1.774E+06	2.639E+08	-1.709E+10	4.990E+11	-5.257E+12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.998922
9	3.123E+01	-7.323E+01	4.147E+06	-9.509E+08	1.233E+11	-9.592E+12	4.569E+14	-1.299E+16	2.019E+17	-1.312E+18	0.000E+00	0.999995
10	3.951E+01	-3.270E+03	8.078E+06	-2.342E+09	3.954E+11	-4.144E+13	2.779E+15	-1.193E+17	3.173E+18	-4.761E+19	3.086E+20	0.999999
11	4.718E+01	-1.702E+03	7.563E+06	-1.910E+09	2.756E+11	-2.405E+13	1.293E+15	-4.176E+16	7.420E+17	-5.552E+18	0.000E+00	0.999997
12	5.778E+01	-7.812E+03	1.475E+07	-4.757E+09	8.999E+11	-1.060E+14	8.009E+15	-3.874E+17	1.160E+19	-1.960E+20	1.428E+21	0.999998
13	6.580E+01	-2.206E+03	1.035E+07	-2.547E+09	3.512E+11	-2.832E+13	1.340E+15	-3.516E+16	4.318E+17	-1.322E+18	0.000E+00	0.999996
14	7.886E+01	-8.415E+03	1.478E+07	-3.247E+09	3.628E+11	-2.120E+13	6.180E+14	-7.017E+15	0.000E+00	0.000E+00	0.000E+00	0.999856
15	5.825E+01	6.121E+04	-1.977E+07	3.811E+09	-3.222E+11	1.231E+13	-1.712E+14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.995377
16	1.013E+02	-8.962E+03	2.062E+07	-5.649E+09	8.644E+11	-7.678E+13	3.944E+15	-1.085E+17	1.237E+18	0.000E+00	0.000E+00	0.999997
17	1.119E+02	-1.853E+03	1.496E+07	-2.765E+09	1.534E+11	2.099E+13	-3.926E+15	2.600E+17	-8.046E+18	9.733E+19	0.000E+00	0.999995
18	1.269E+02	-7.603E+03	2.246E+07	-5.632E+09	7.628E+11	-5.561E+13	1.893E+15	-1.649E+15	-1.648E+18	3.184E+19	0.000E+00	0.999996
19	8.306E+01	1.279E+05	-5.256E+07	1.126E+10	-1.062E+12	4.536E+13	-7.085E+14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.991278
20	1.627E+02	-2.959E+04	4.734E+07	-1.496E+10	2.622E+12	-2.648E+14	1.536E+16	-4.742E+17	6.045E+18	0.000E+00	0.000E+00	0.999991
21	1.794E+02	-3.579E+04	6.077E+07	-2.360E+10	5.533E+12	-8.220E+14	7.926E+16	-4.940E+18	1.921E+20	-4.236E+21	4.051E+22	0.999999
22	1.971E+02	-3.700E+04	5.838E+07	-1.858E+10	3.276E+12	-3.328E+14	1.940E+16	-6.016E+17	7.693E+18	0.000E+00	0.000E+00	0.999992
23	2.135E+02	-3.575E+04	6.160E+07	-2.015E+10	3.592E+12	-3.603E+14	2.016E+16	-5.677E+17	5.123E+18	4.486E+19	0.000E+00	0.999957
24	1.728E+02	1.187E+05	-4.413E+07	1.109E+10	-1.178E+12	5.594E+13	-9.571E+14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.997350
25	2.690E+02	-3.024E+04	5.989E+07	-1.636E+10	2.295E+12	-1.398E+14	-1.698E+15	7.240E+17	-3.705E+19	6.297E+20	0.000E+00	0.999996
26	2.757E+02	-5.445E+04	8.638E+07	-2.907E+10	5.503E+12	-6.047E+14	3.835E+16	-1.298E+18	1.819E+19	0.000E+00	0.000E+00	0.999994

Table 89. LET Lookup tables for Primary Particles in Detector 2 with Delta Ray Correction for Protons and Alphas using equation y=a+b/x+c/x^2+d/x^3+e/x^4+f/x^5+g/x^6+h/x^7+i/x^8+j/x^9 (The lower case column headers are the equation coefficients)

Atomic No.	a	b	c	d	e	f	g	h	i	j	k	DoF adj. r2
1	0.326751	73.108025	15488.986	-2995728	308935247	-1.88E+10	6.902E+11	-1.5E+13	1.783E+14	-8.82E+14	0.000E+00	0.999995
2	1.308527	292.36205	54721.498	-9972675	970723381	-5.58E+10	1.946E+12	-4.03E+13	4.567E+14	-2.17E+15	0.000E+00	0.999995
3	3.314E+00	3.746E+02	1.913E+05	-2.877E+07	2.298E+09	-1.040E+11	2.673E+12	-3.613E+13	1.993E+14	0.000E+00	0.000E+00	0.999993
4	6.246E+00	-2.878E+02	1.056E+06	-2.774E+08	4.194E+10	-3.911E+12	2.320E+14	-8.758E+15	2.033E+17	-2.642E+18	1.469E+19	0.999998
5	1.053E+01	-6.226E+02	8.019E+05	-7.041E+07	2.515E+09	-2.975E+10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.997088
6	1.060E+01	7.041E+03	-1.830E+06	3.679E+08	-3.346E+10	1.501E+12	-3.185E+13	2.543E+14	0.000E+00	0.000E+00	0.000E+00	0.997489
7	1.944E+01	-2.037E+03	4.382E+06	-1.331E+09	2.354E+11	-2.570E+13	1.780E+15	-7.792E+16	2.077E+18	-3.053E+19	1.883E+20	0.999997
8	2.769E+01	-7.881E+03	8.125E+06	-1.896E+09	2.195E+11	-1.317E+13	3.914E+14	-4.528E+15	0.000E+00	0.000E+00	0.000E+00	0.999160
9	4.385E+01	-2.230E+04	1.117E+07	-1.543E+09	9.596E+10	-2.642E+12	2.616E+13	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.964649
10	2.323E+01	3.768E+04	-1.853E+07	4.646E+09	-5.367E+11	3.097E+13	-8.597E+14	9.115E+15	0.000E+00	0.000E+00	0.000E+00	0.985173
11	2.924E+01	3.947E+04	-1.583E+07	3.404E+09	-3.215E+11	1.372E+13	-2.137E+14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.992253
12	7.865E+01	-4.669E+04	2.676E+07	-4.462E+09	3.363E+11	-1.128E+13	1.365E+14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.977343
13	1.104E+02	-1.476E+05	1.433E+08	-5.348E+10	1.039E+13	-1.146E+15	7.427E+16	-2.787E+18	5.589E+19	-4.629E+20	0.000E+00	0.980223
14	4.356E+01	8.640E+04	-5.170E+07	1.492E+10	-1.998E+12	1.346E+14	-4.383E+15	5.470E+16	0.000E+00	0.000E+00	0.000E+00	0.992983
15	1.404E+02	-1.836E+05	1.899E+08	-7.619E+10	1.598E+13	-1.905E+15	1.331E+17	-5.382E+18	1.161E+20	-1.033E+21	0.000E+00	0.975302
16	6.628E+01	9.370E+04	-6.166E+07	2.070E+10	-3.276E+12	2.713E+14	-1.188E+16	2.569E+17	-2.128E+18	0.000E+00	0.000E+00	0.988289
17	5.705E+01	1.535E+05	-1.022E+08	3.166E+10	-4.591E+12	3.368E+14	-1.201E+16	1.646E+17	0.000E+00	0.000E+00	0.000E+00	0.990725
18	1.962E+02	-2.507E+05	2.695E+08	-1.132E+11	2.500E+13	-3.149E+15	2.333E+17	-1.001E+19	2.297E+20	-2.177E+21	0.000E+00	0.994336
19	2.131E+02	-2.703E+05	3.081E+08	-1.388E+11	3.304E+13	-4.488E+15	3.585E+17	-1.659E+19	4.105E+20	-4.194E+21	0.000E+00	0.992509
20	2.861E+01	5.287E+05	-7.078E+08	4.498E+11	-1.504E+14	2.928E+16	-3.484E+18	2.563E+20	-1.135E+22	2.772E+23	-2.861E+24	0.986305
21	2.227E+01	6.198E+05	-8.272E+08	5.222E+11	-1.736E+14	3.357E+16	-3.968E+18	2.900E+20	-1.276E+22	3.093E+23	-3.171E+24	0.982121
22	2.946E+02	-3.866E+05	4.237E+08	-1.814E+11	4.015E+13	-4.906E+15	3.331E+17	-1.173E+19	1.666E+20	0.000E+00	0.000E+00	0.987113
23	5.772E+01	6.203E+05	-8.429E+08	5.476E+11	-1.869E+14	3.706E+16	-4.486E+18	3.354E+20	-1.510E+22	3.743E+23	-3.922E+24	0.993430
24	1.537E+02	2.101E+05	-1.570E+08	5.941E+10	-1.037E+13	9.061E+14	-3.812E+16	6.111E+17	0.000E+00	0.000E+00	0.000E+00	0.982607
25	4.369E+02	-7.599E+05	9.251E+08	-4.697E+11	1.257E+14	-1.920E+16	1.724E+18	-8.981E+19	2.505E+21	-2.891E+22	0.000E+00	0.980107
26	7.545E+01	8.116E+05	-1.160E+09	7.988E+11	-2.911E+14	6.203E+16	-8.100E+18	6.555E+20	-3.199E+22	8.610E+23	-9.803E+24	0.995247

Table 90. Energy Ranges (in MeV/nucleon) used for Production of Primary Particle LET Lookup Tables in MeV/nucleon

Atomic No.	D1	D2	TEP1	D3	D4	TEP2	D5	D6
1	20-3000	20-3000	55-3000	95-3000	95-3000	95-3000	120-3000	120-3000
2	20-3000	20-3000	50-3000	95-3000	95-3000	100-3000	120-3000	120-3000
3	20-3000	20-3000	50-3000	110-3000	110-3000	120-3000	140-3000	140-3000
4	20-3000	25-3000	75-3000	130-3000	130-3000	130-3000	160-3000	160-3000
5	25-3000	25-3000	50-3000	150-3000	150-3000	150-3000	190-3000	190-3000
6	25-3000	25-3000	60-3000	170-3000	170-3000	180-3000	300-3000	300-3000
7	25-3000	30-3000	60-3000	190-3000	190-3000	190-3000	300-3000	300-3000
8	25-3000	35-3000	75-3000	200-3000	300-3000	300-3000	300-3000	300-3000
9	30-3000	30-3000	45-3000	300-3000	300-3000	300-3000	300-3000	300-3000
10	30-3000	35-3000	50-3000	300-3000	300-3000	300-3000	300-3000	300-3000
11	35-3000	40-3000	50-3000	300-3000	300-3000	300-3000	300-3000	300-3000
12	35-3000	35-3000	50-3000	300-3000	300-3000	300-3000	400-3000	400-3000
13	35-3000	35-3000	60-3000	300-3000	300-3000	300-3000	400-3000	400-3000
14	35-3000	40-3000	60-3000	300-3000	300-3000	300-3000	400-3000	400-3000
15	35-3000	40-3000	60-3000	300-3000	300-3000	300-3000	400-3000	400-3000
16	40-3000	40-3000	75-3000	400-3000	400-3000	400-3000	400-3000	400-3000
17	40-3000	45-3000	65-3000	400-3000	400-3000	400-3000	400-3000	400-3000
18	40-3000	40-3000	70-3000	400-3000	400-3000	400-3000	400-3000	400-3000
19	40-3000	45-3000	70-3000	400-3000	400-3000	400-3000	500-3000	500-3000
20	45-3000	50-3000	70-3000	400-3000	400-3000	400-3000	500-3000	500-3000
21	45-3000	50-3000	70-3000	400-3000	400-3000	400-3000	500-3000	500-3000
22	45-3000	55-3000	75-3000	400-3000	400-3000	400-3000	500-3000	500-3000
23	45-3000	50-3000	80-3000	400-3000	400-3000	400-3000	500-3000	500-3000
24	45-3000	50-3000	70-3000	400-3000	400-3000	500-3000	500-3000	500-3000
25	45-3000	50-3000	85-3000	400-3000	400-3000	400-3000	500-3000	500-3000
26	50-3000	55-3000	75-3000	400-3000	400-3000	500-3000	600-3000	600-3000

Table 91. Energy Ranges (in MeV/nucleon) used for Production of Secondary Particles LET Lookup Tables in MeV/nucleon

Atomic No.	D1	D2	TEP1	D3	D4	TEP2	D5	D6
1	20-3000	20-3000	20-3000	20-3000	20-3000	20-3000	20-3000	20-3000
2	90-3000	70-3000	300-3000	90-3000	90-3000	90-3000	95-3000	110-3000
3	45-3000	50-3000	55-3000	110-3000	110-3000	110-3000	120-3000	130-3000
4	50-3000	35-3000	65-3000	120-3000	120-3000	110-3000	150-3000	150-3000
5	35-3000	40-3000	70-3000	110-3000	140-3000	150-3000	150-3000	150-3000
6	35-3000	40-3000	85-3000	150-3000	150-3000	150-3000	170-3000	160-3000
7	30-3000	35-3000	60-3000	150-3000	170-3000	180-3000	190-3000	190-3000
8	30-3000	35-3000	75-3000	120-3000	120-3000	180-3000	300-3000	300-3000
9	30-3000	30-3000	55-3000	160-3000	170-3000	300-3000	300-3000	300-3000
10	40-3000	40-3000	85-3000	120-3000	160-3000	300-3000	300-3000	300-3000
11	35-3000	40-3000	85-3000	190-3000	300-3000	300-3000	300-3000	300-3000
12	40-3000	45-3000	85-3000	180-3000	180-3000	300-3000	300-3000	300-3000
13	35-3000	45-3000	110-3000	300-3000	300-3000	300-3000	300-3000	300-3000
14	35-3000	40-3000	60-3000	300-3000	300-3000	300-3000	400-3000	400-3000
15	40-3000	45-3000	85-3000	300-3000	300-3000	300-3000	300-3000	400-3000
16	40-3000	45-3000	130-3000	300-3000	300-3000	300-3000	400-3000	400-3000
17	30-3000	45-3000	150-3000	300-3000	300-3000	400-3000	400-3000	400-3000
18	40-3000	45-3000	300-3000	300-3000	300-3000	400-3000	400-3000	400-3000
19	40-3000	45-3000	190-3000	300-3000	400-3000	400-3000	400-3000	400-3000
20	45-3000	55-3000	140-3000	300-3000	300-3000	400-3000	400-3000	400-3000
21	45-3000	50-3000	140-3000	300-3000	300-3000	400-3000	400-3000	400-3000
22	45-3000	50-3000	95-3000	400-3000	400-3000	400-3000	500-3000	500-3000
23	40-3000	45-3000	80-3000	400-3000	400-3000	400-3000	400-3000	400-3000
24	45-3000	50-3000	110-3000	400-3000	400-3000	500-3000	500-3000	500-3000
25	45-3000	50-3000	85-3000	400-3000	400-3000	400-3000	500-3000	500-3000
26	50-3000	50-3000	90-3000	90-3000	400-3000	500-3000	500-3000	500-3000

VITA

Jamie Alicia Anderson was born on April 29, 1985 in Knoxville, TN. She grew up in Knoxville and graduated from Carter High School in 2003. She matriculated at the University of TN at Knoxville in the Fall of 2003. She graduated with a B.S. in Nuclear Engineering, Health Physics concentration with a Minor in Business Administration in May, 2008. She entered graduate school right after in the fall of 2008 and obtained her M.S. in Nuclear Engineering, Health Physics concentration from the University of Tennessee in December 2009. After completion of her doctoral degree, she is planning on pursuing a career as a university faculty member.